TEST PIECES FOR BARS AND PLATES.

BY WILLIAM HACKNEY, SB. C.

At the ordinary meeting of the Institution of Civil Engineers, on Tuesday, January, 22, Sir Frederick Bramwell, F. R. S., vice-president, in the chair, a paper was read on "The Adoption of Standard forms of Test Pieces for Bars and Plates," by Mr. William Hackney, B. Sc., Assoc. M. Inst. C. E., of which the following is an abstract:

In breaking test pieces of the same quality of tough metal by direct tension, very different results were obtained according to the form of the test piece employed. The sample that one engineer would define as stretching nearly 44 per cent. before fracture was classed by another, using a test piece of different form, as stretching less than 28 per cent. In fact, to obtain from any bar of metal relatively high percentages of ultimate stretching, all that was needed was to use short or thick test pieces. Mr. J Barba had shown in a paper published in the *Memoires de la Societe des Ingenieurs Civils* in 1880, that the test pieces of the same form, namely in which the ratio of length to diameter was the same, gave the same percentage of ultimate stretching whatever their size might be; but that in those of equal length but differing in diameter, or of equal diameter but of different lengths, the percentages of ultimate stretching varied very much.

Notwithstanding the extent to which the result obtained in testing a sample of ductile metal was thus affected by the proportions of the test piece used, no standard dimensions or proportions for such pieces had been generally adopted, and those in common use varied very much. Sir Joseph Whitworth, for instance, advocated the use of a test piece 0.798 inch in diameter by 2 inches long, or 2.51 diameters long, and the test piece in use at Woolwich Arsenal was 3.75 diameters in length. From these proportions the ratio of length to diameter was increased in the test pieces adopted by different engineers, especially on the Continent, to 10 or even more. The ultimate stretching of test pieces cut from the same bar of mild steel, similar in form at the ends and of these different proportions, would be:

Ratio of length to ultimate stretching diameter.	per cent.
2.51	44.5
3.75	37.5
10.00	28.2

The proportions of the strips, in which plates and flat bars were tested, had almost as great an influence on the percentages of ultimate stretching as had the proportions of cylindrical test pieces, and those in general use varied nearly as much.

Mr. Barba showed that, in the case of pieces cut by lathe or planing-machine from the same bar of metal, the law of similarity, that was the law that test pieces similar in form gave the same percentage of ultimate extension, whatever their size, was as strictly true in the case of flat as in that of cylindrical test pieces.

The effect on the percentage of stretching of the traverse dimensions of an ordinary strip of plate or flat bar was not so great as in the case of a cylindrical test piece, as in the strip, whatever might be the width, the thickness remains always that of the piece of metal tested.

Test strips of mild steel plates, 0·5-inch thick and about 1·4-inch wide, that stretched 27·5 per cent. in a length of 8 inches, stretched 37·3 per cent. if the measured portions were only 2 inches long; and in rather harder plates, which stretched 20 per cent. in a length of 8 inches, the extension in 6 inches was 25 per cent., and in 4 inches about 32 per cent. The test strips used at the Crewe Works of the London and North Western Railway Company were only 2 inches long, and those employed in some tests of boiler plates made at Sheerness Dockyard in 1875, and at Chatham Dockyard in 1879, were 4 inches long; but the length of test-strip adopted for plates, both in this country and abroad, was almost universally 8 in.

The impossibility of comparing the results of tests made by different experimenters of the ultimate stretching of metals, in the absence of standard forms of test pieces, had long been felt by engineers, and had led to the adoption of several alternative methods of comparing their relative toughnesses.

When a bar of ductile metal was stretched to breaking, it at first extended equally from end to end, with each successive increment of load, until the maximum load that it could carry had been reached, and up to this point the percentage of stretching was absolutely independent of the proportions of the test piece used. This percentage of extension would thus appear to be the most important in comparing the structural values of metals, and to be that which should be always the most particularly noted; but practically testing in this way would be more tedious than the ordinary mode of loading the piece until it broke, and then measuring the elongation after fracture; so that in ordinary technical and commercial work this latter plan would always be preferred.

Another method that had been adopted to a considerable extent for obtaining comparable measurements of toughness of metals, without using test pieces of uniform proportion, had been to measure not the linear stretching, but the percentage of contraction of area at the point of fracture. Practical objections, however, to this were that the contraction of area could be much less accurately measured than the increase in length, and that as a tough piece of metal often broke irregularly, it might be difficult to determine what its exact diameter at the point of fracture should be taken to be. Whether on account of the difficulty of accurate measurement, or owing to the percentage of contraction of area not being exactly proportional to that of stretching, it was certain that the results obtained by the two modes of measurement seldom precisely agreed.

A third mode of obtaining comparable results in testing by tension, would be to use very long test-pieces and to reject the percentages of stretching near to the point of fracture; but this would be expensive, and often inconvenient or even impracticable, and would not always give accurate results; for a long bar, when stretched to breaking, often began to draw down simultaneously in several parts of its length. The use of comparatively short test-pieces of some standard forms, seemed thus to be the best method of making tests of the quality of bars and plates of ductile metal that could be employed.

The length of 8 in., in the testing of plates, was the only dimension of test-piece that appeared to be generally adopted; and as it was very desirable that the standard forms for cylindrical and for flat test pieces should be such that the same metal might give the same percentage of stretching, whether tested in the one shape or in the other, this length, with a convenient width and an average thickness, might well be taken as the standard form, and that for cylindrical test-pieces be determined by experiment, so as to correspond with it.

The effect of hammering or rolling in increasing the toughness of metals was so marked, that in determining the shape of the cylindrical test piece that would give the same percentage of ultimate stretching as the standard form adopted for plates, both shapes should be cut by lathe or planing machine from the same bar, so that one might not be made from metal more drawn down than the other. This increase in the toughness of iron and steel explained the fact that in testing plates and rivet-bars it was found that metal of the same quality stretched nearly as much in test pieces of the same length, whether the bars and plates were thick or thin. The use of a test piece 8 in. long was a more severe trial for a thinner than for a thicker plate; but the toughness of the former had been so much increased by the greater amount of rolling to which it had been subjected, that the one stretched before fracture nearly as much as the other.

As test pieces similar in form had been found to give the same percentage of ultimate stretching, whatever their size, it might be better to define the standard cylindrical test piece rather as being of a certain form than of a particular length. This would facilitate the adoption of the same form by engineers of different countries, using different units of measure. In testing plates and bars such as rivet bars, which were reduced to the size of the test piece by hammering or rolling, it would be best to retain, as at present, one length of test piece, whatever the transverse dimensions. In fixing the standard forms, the effect on the percentage of stretching of the distance from the datum points of the test pieces of the shoulders or enlargements at the ends by which they are to be fixed in the testing machine should not be overlooked. The enlargement might begin for instance, half a diameter beyond each datum point, and its radius of curvature might also be half a diameter.

The whole subject of the testing of metals by tension seemed to be well worthy of consideration. If a uniform system of testing could be generally introduced, so that tests made by engineers in all parts of the world might be directly comparable, the advantage would be very great.

THE bill appropriating $150,000 to build a branch penitentiary at Eddyville, Lyon Co., Ky., was passed by a vote of 51 to 27 in the Kentucky Legislature.

THE TEMPERING OF BRONZE.

No doubt, native copper attracted the attention of primitive man before any of its alloys; but the difficulty of working it for a long time prevented its general use. How the metal came to be associated with tin in various forms is entirely unknown to us. Arms and implements of bronze in Egypt, Greece, and Gaul, present a constant proportion of tin—twelve per cent. The bronze of cannons is eight to eleven per cent.; of bells, twenty to thirty per cent. Recently at Réalon (Hautes-Alpes), a peddler's pack of bronze objects has been unearthed, showing eighteen per cent. of tin.

The founders of prehistoric times seem to have had three methods of procedure:

1°. The alloy was poured into a mould of stone or metal in two pieces. The ridge formed by the juncture was afterwards hammered down.

2°. A model of wood was pressed upon a layer of sand in a box, to obtain a negative of one side: a corresponding operation gave a mould of the other side. The two boxes fitted together completed the mould. There were still seams requiring to be hammered.

3°. A model of wax was surrounded with soft clay. The clay was then heated to harden it and to melt the wax. The metal was introduced at the opening left for the escape of the wax.

Soldering was unknown to the men of the bronze age; mending was done by riveting. The art of softening bronze was known to the ancients Proclus says (Works and Days, line 1842) that "in ancient times men used bronze in cultivating the ground just as they use iron now; but that copper being soft in its nature, they hardened it by immersion." Eustathius also says (Iliad, book I., line 236) that they tempered the bronze when using it in place of iron. The chemist Darcet, at the end of the last century, showed: 1. That pure copper, heated to redness and plunged into cold water, is neither hardened nor softened: 2. Bronzes having only tin alloy, and that less than thirty per cent., heated and cooled in air, become weak and brittle; 3. The same bronzes, heated and cooled in water, are softened, and become very tractable.

It is nearly certain that the men of the bronze age tempered their implements in taking them from the mould. Those destined to stand a blow were left in this state. Arms and tools needing more temper were heated over, and cooled in the air.

Another prehistoric art, rediscovered by the engineers of Alexandria, and recently again brought to light from the orient, is rendering bronze flexible. This property of flexibility is certainly possessed by some very ancient specimens. The engineer Philo, who lived in the century before our era, describes, in his 'Treatise on Artillery,' the fabrication of springs of bronze needed in some of his machinery.

The author from whom the foregoing notes are taken, A. de Rochas, will soon publish, through Masson at Paris, a volume on the origin of industry, and the first application of the sciences.—(*Rev. scient.*, Sept. 22.) *Science.*

THE PANAMA CANAL.

NEW ORLEANS, Feb. 17.—The United States steam-ship Tennessee, flag-ship of the North Atlantic squadron, has arrived here after a week's stay at Aspinwall. Lieut. Kimball, of that vessel, was also there one year ago, and both times he inspected the entire work which was being done on De Lesseps Panama Canal. He says that since last year a great deal of work had been done, and at present every section but two had been let out to contractors. These two embrace difficult portions and are being constructed by the company. Work is being rapidly pushed all along the line. Between 15,000 and 20,000 Jamaica negroes are employed under the direction of the French Engineers. Several large American dredging machines are being used. The Panama Road is brought into play to transport material, while for the "dump" railway to draw the excavation away, nearly 150 new locomotives have been contracted for. Great difficulty is being encountered in the Chagres River, which crosses the canal at right angles. The engineers determined to dam it up entirely, and dig an entry near the new channel for it into the Gulf, parallel to the line of the canal. At the rate work is going on the canal will be ready for opening in five or six years. The French director at Aspinwall has been assured that money enough will be furnished to push the enterprise vigorously to completion.

THE New River and Chambers Valley railroad Va., has been incorporated.

LEXINGTON'S FOUNTAINS.

Correspondence of the Courier Journal.

LEXINGTON, Ky., Jan. 24.—I've been talking to the Mayor on water works, and I reckon we are going to have the daisiest thing in that line the world has ever seen. As for fountains you just ought to hear our programme. None of your Cincinnati fountains, with a half-dozen cupids and nondescript sea urchins blowing up water through mint julep rye-straws, but something in that line that just lays in the shade anything they can do at Fontainbleau, Versailles, Sydenham or Trafalgar Square.

That water should ever have succeeded in attracting the average Lexington man is a miracle, which discounts Lourdes, and gets away with anything short of Cana of Galilee, and when it is remembered that right on top of this we are starting an immense soap factory, it is natural that the philanthropists in our city should feel happy that a long-felt want is to be supplied—an aching void to be filled.

The way this water works rage came about is a little singular. Messrs. Dennis Mulligan and Claud M. Johnson became rival candidates for the Mayoralty of this city. Mr. Mulligan is a foreigner, his name proclaiming his French origin. Mr. Johnson's name proclaims his aristocratic Kentucky origin. Mr. Mulligan is a dealer in whiskies. As a fluid, it's hard to beat in Lexington. Mr. Mulligan has ancient whiskies—whiskies excavated at Pompeii and Herculaneum, buried on that sad occasion when Vesuvius assumed a clerical role and conducted the burial services for those two places, concluding with "ashes to ashes;" whiskies with a prehistoric American Government brand on them, marked "Old Crow," dated 1491, and made by the Indians a year before Columbus came over here yachting; whiskies whose age can only be reckoned by Chinese chronology, and that have a picture of the laying of the corner-stone of the "great wall" for a trade-mark. It looked like Dennis held three aces, and that there was nothing in the deck that could beat him, for it was known that he was going to knock out the heads of enough barrels to set one on each corner in town on election day, with tin cups tied to them by hemp-strings, like Gen. Gentry has ice-water at the fair, and about a cord and a half of souvenir bottles at each barrel with a quart in each, and a green seal, bearing this strange device, "Mulligan—early and often."

As an instance of valor, history does not record a parallel to the conception that would attack a proposition of that sort with water in the town of Lexington. David before Goliath, Leonidas at Thermopylæ, the bare-handed son of Manoah before the Nemean lion, pale their ineffectual fires in the brilliancy of this comparison. To dam the Nile with bullrushes, to fetter the steps of American freedom, to raze the walls of Jericho with a ram's horn, to shackle the Adriatic with a trace-chain and clean the Augean stables with a dinner fork, were but child's play, and if Claude does beat him with such odds, and the Senatorial deadlock is still on, Lexington would settle that muddle as quick as lightning can from here to Frankfort, by telegraphing Mulligan's own boy to nominate Claude for the United States Senate.

Private gentlemen are going to great expense in the get-up of fountains. Mr. Gratz of the *Gazette*, is an enthusiast on the subject of water-works. He will have in front of his house a magnificent Neptune, that, with inflated cheeks, will blow out of a sea-shell a stream of water large enough to run a small grist mill. The conception of a figure that blows up something has been pronounced peculiarly apposite for a Lexington editor. The untutored suppose the trident of that ancient mariner to be some kind of a classic pitchfork, and to have reference to Mr. Gratz's former connection with the Society of Grangers.

As an evidence of f ith in Providence, history records only two cases that compare with the Lexington water-works. The first is when Moses struck the rock in the barren wilderness and a stream gushed forth to quench the thirst of the host of Israel, and the other is when Brother Barnes started the "Pink Cottage" at Stanford.

The City Council has voted $10,000 a year to pay for this water, and a New York company has a mortgage on the new court-house to secure the payment, and yet the mai s from this city are going to run out onto the farm of Gen. Preston, two miles and a half from town, where to-day, after all the ra'n and slush we have had, there is not enough wa er to make first-class navigation for a gander, and where the frogs died last summer begging, like Dives in hell, for a drop of water to cool their parched tongues.

Pennsylvania's first Railroad.

The Philadelphia *Press* gives the following account of the first railroad built in Pennsylvania:

In 1825 the Schuylkill Canal was opened to Mount Carbon, then a suburb of Pottsville, and this borough was erected February 19, 1828. and in 1829 the fever of speculation brought hundreds of people here; in 1826 and 1827 Mr. Abraham Pott built a railroad extending half a mile in length near this place. The railroad was made of wooden rails, laid on wooden sills, and was successfully operated in carrying coal, which previous to that time was hauled in wagons to the canal, and thence sent to market. And it was in 1829 that the Directors of the Schuylkill Canal came here and viewed this primitive road in operation. They were taken by surprise when they saw thirteen railroad cars loaded with one and a half tons each, but they were really shocked when old Abe Pott, the projector of this corduroy railroad, told them that in less than ten years a railroad would be in operation along the line of their canal. After events proved that old Abe was right in every thing except as to time, for it was not until 1842 that the first train passed over the new extension of the Philadelphia and Reading Railroad from Mount Carbon.

And here we must record the fact that, had it not been for the driving of the Port Clinton tunnel, which was for many years the only obstacle to the extension of the Reading Railroad to the coal regions. "Old Abe" would have been entirely right. And this little bit of almost forgotten history tempts us to record, also, what seems to be a piece of stupid railroad engineering—that is, a few years ago—the skillful engineering sagacity of Wm. Lorenz, the present able chief engineer of the Philadelphia and Reading Railroad, found out there was no necessity at all for a tunnel at Port Clinton, and a railroad was built around the Blue Mountain, through which this expensive tunnel was built.

West Virginia Roads.

Two railroads are being built in West Virginia which will have a great effect in developing and building up that State, whose resources are so varied and valuable. One of these is the West Virginia Central and Pittsburg, known as the Blaine road, that leaves the Baltimore and Ohio at Piedmont and takes a south-easterly direction at the foot of the Laurel Hill Mountains and along the Cheat River. Only twenty-four miles of this road have been built.

The other road is the Clarksburg, Weston and Glenville, of which twenty-six miles is in operation, that leaves the Baltimore and Ohio at Clarksburg and runs southwardly in the Valley of Monongahela River.

West Virginia is in great need of additional railroad facilities. The Baltimore and Ohio traverses the northern part and the Chesapeake and Ohio runs near the southern boundary, but the great central section between these lines, the Apalachian Range and the Ohio River, is sparsely settled and entirely destitute of railroads. Yet this undeveloped territory is a vast mine of wealth. Coal of the finest quality and iron of unsurpassed purity are everywhere found. Petroleum is supposed to underlie the coal, while everywhere is the virgin forest of huge black walnut and other valuable trees. There is an abundance, too, of the best kind of grazing and farming lands.

The two roads we have mentioned are slowly pushing down through the forests of this almost unexplored wilderness. For, although it is divided into counties and has some population, its resources are imperfectly known. It is said that the owners of the two railroads are more than satisfied with the returns from their investments, and expect out of them to amass great fortunes.

It has always seemed strange that Eastern capitalists have neglected this promising field for so long a time. It is pleasant to know that they have at last taken hold and undertaken to supply wants that have existed for so many years.—*Railway Register*.

TAY CANAL.—The work on this branch of the Rideau Canal, says the Perth, Ont., *Courier* embraces the construction of a dam and two locks 134x32 feet each having a depth at the lowest stage of water of 5 feet 6 inches, and also the deepening of the channel of the river Tay, where required, which will probaly be a number of places.

The sum of $100,000 has been placed in the estimates for the construction of the Tay Canal, to be spent during the financial year commencing on the 1st of July 1884. This is in addition to $75,000 voted for the current financial year.

The Traveller Used in the Erection of the Niagara Cantilever Bridge.

The exceedingly rapid erection of the Cantilever Bridge at Niagara was due to its design and to the systematic handling of the parts forming the trusses.

Through the courtesy of Mr. C. C. Schneider, the Chief Engineer of the bridge and its designer, we are enabled to give the readers of ENGINEERING NEWS a view of one of the two travellers used in its construction.

In our issue of October 6, 1883, we gave a general elevation of the bridge, the form of which is now well-known. False works were used only in the erection of the shore arms of the cantilevers, the river arms, being self-supporting by their design, were built by the aid of the traveller illustrated. The two bridge trusses are 28 ft. between centres, and the panels are each 25 ft. long, from *c.* to *c.* of posts, on the cantilevers, and 24 ft. long on the intermediate span. The depth of truss was 56 ft. over the towers and 26 ft. at the river end; the upper chord was horizontal as shown on the plan referred to.

From out to out this traveler was 66 ft. 6 in. long, the overhang, beyond the completed truss was 40 ft. The extreme height was 21 ft. and the width over all 38 ft. 6 in. The dimensions of the timber and the iron used in its construction are generally given upon the plans; though it should be mentioned that all rods, either square or round, were provided with upset screw-ends. Six cast-iron wheels, each 14 in. in diameter and 8 in. face, ran upon two of the longitudinal stringers, between guides as shown, and supported the structure.

The rear end of the traveller was anchored to the truss by six clamp-hooks, catching under the upper plates and angles of the transverse floor beams; four of these hooks were attached to the last pannel completed, two others were used in connection with a system of diagonal beams and brace planks, and wire rope guys, extending as out-riggers from the rear of the traveller. These hooks were connected with 1¾ in. round iron rods passing up through timbers provided, and furnished at the top with nut and washer plates; by screwing up on these nuts the clamps held the traveller firmly down to the truss.

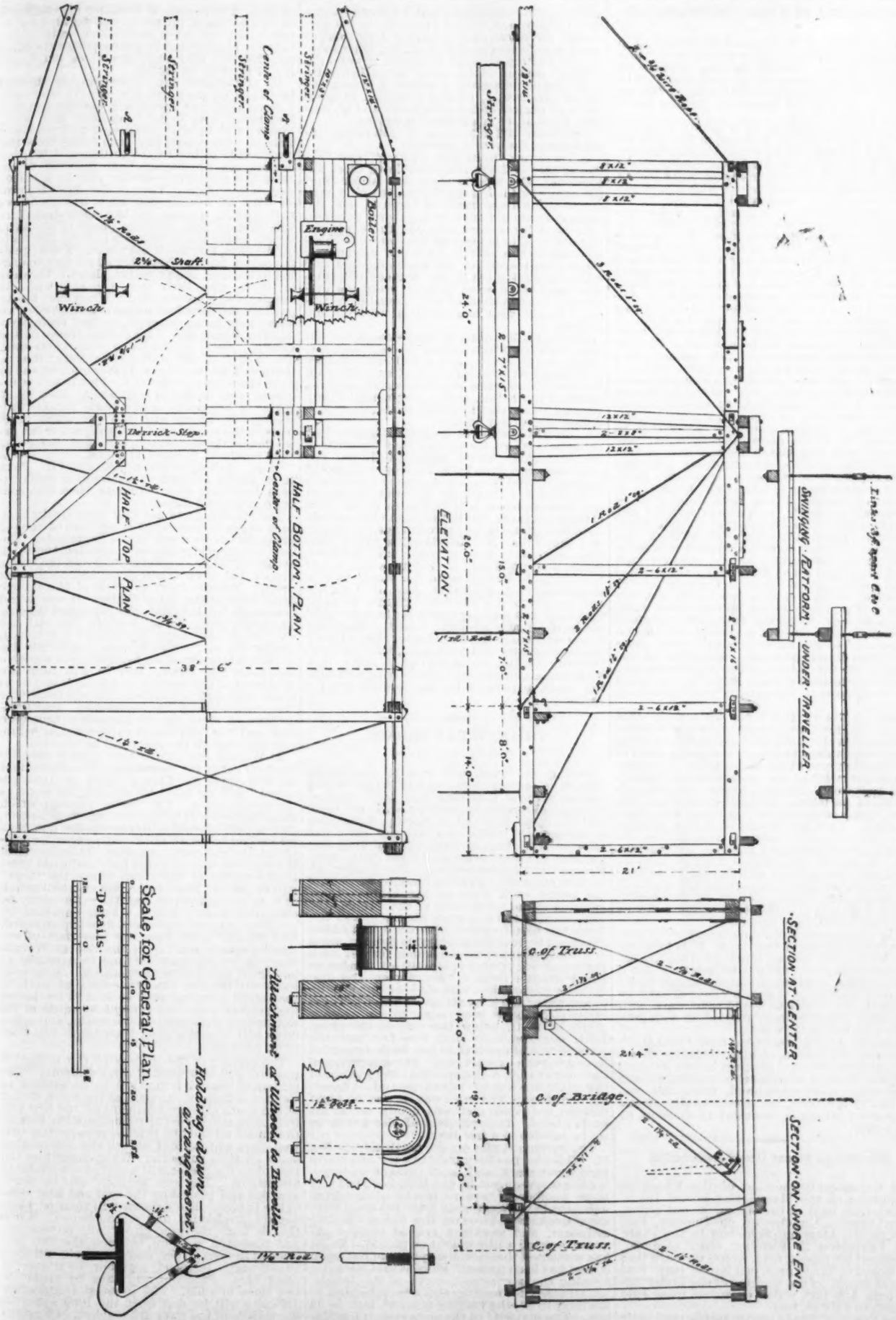
The traveler was moved forward as each panel was completed by passing ropes, attached to the front of the last pannel, over the sheaves *A. A.* back to the winches shown on the plan.

A track in the centre of the traveller conveyed the bridge members under two derricks of strong but ordinary construction. The handling was done by a Copeland & Bacon engine, 7½ in. cylinder, 8 in. stroke, which by appropriate shafts and gearing operated the two sets of winches. A vertical tubular boiler located upon the rear end of the traveller platform supplied the power.

The heaviest members handled from this traveller were posts and bottom chord sections, the maximum weight being 12,000 pounds.

For the safety and convenience of the workmen while connecting the different parts, a hanging platform was used, suspended from the front end of the traveller by 1 in. round iron rods. As the bottom chord of the truss gained in elevation as the structure neared mid-stream, links 3 ft. long were put into the lower ends of the suspension rods: this distance was just equal to the rise in each panel length, and the height of the platform could always be adjusted by removing one set of links at each advance.

A GENTLEMAN acquainted with the affairs of the Junction Railroad says that by tripartite agreement, which holds good for 40 years, the Baltimore & Ohio and Pittsburg & Western are to interchange traffic, on which the Junction will get a certain percentage on each car. The road will have no rolling stock and only two engines, as the other roads will furnish the motive power.



TRAVELLER USED AT THE NEW NIAGARA BRIDGE.

BLASTING POWDER.—RACKAROCK.

Gen. Abbot, U. S. Corps of Engineers, as an addendum to his valuable report upon "Submarine Mines," issued in 1881, submits the following in substance, as the result of his tests of the blasting powder known as "Rackarock," made by the Rendrock Powder Co. of New York.

Rackarock consists of a solid, composed mainly of potassium chlorate, in fine powder, given a reddish tint by some coloring matter; and of an oily liquid, having the strong, bitter almond smell characteristic of nitro-benzol. These compounds, neither of which is explosive by itself, are combined before use by immersing the solid in the liquid for a few seconds until an increase in weight of about one-third is effected by absorption. The solid is supplied in the form of loosely-packed cartridges of different sizes, put up in bags closed at each end. The combination of the ingredients is effected by means of an open basket of wire to receive the cartridges, which is suspended from a spring-balance and dipped in a galvanized iron pail containing the fluid. A little attention to the time of immersion renders the absorption fairly uniform. The explosive, when prepared in this manner, is a compact red solid, having a specific gravity of about 1.7. It decrepitates with difficulty when hammered on an anvil, but hardly ignites on wood. A fuse containing 24 grains of fulminating mercury fails to explode a cartridge unconfined or loosely confined. Even if it be compacted in an augur-hole in a log and tamped with mud, the explosive is only partial. A cartridge struck by a bullet from a Springfield rifle flashes but does not detonate. Ordinary friction seems to have little tendency to cause explosion. These facts show it to be quite safe to handle, even when ready for use, and has given excellent results in rock-blasting under General Newton at Flood Rock. Its peculiar chemical composition gives rackarock the interest of novelty among modern high explosives, and it has accordingly been tested with special care to discover the intensity of action of which it is capable when fired under water. Two fluids were supplied for the trials, the usual one consisting essentially of nitro-benzol, and the other of a special preparation consisting of the same saturated with picric acid from 12 to 16 per cent., according to the quality of the solvent. The explosives prepared by absorbing these fluids by the solid are designated as "rackarock" and "rackarock special."

The results of the firing tests show that rackarock, fired under water, gives a relative efficiency in the horizontal plane of 0.86, being nearly equivalent to gun cotton, and a study of the results proved that there is no difference in the intensity of action between rackarock and rackarock special, which exceeds the range of variation with either of them, but there was a considerable variation with each of them. That this should be so in a mixture of which the ingredients are combined by the rough method described above is not surprising. Moreover, nitro-bensol itself (formed by treating crude benzine with fuming nitric acid) is certainly subject to important variations in chemical composition, due to its impurities; and the same is probably true of the solid as supplied in the trade cartridges.

The anomalous variations noted were confined to the firing of two days. It is to be regretted that the causes which produce the excessive pressures could not be detected; for if the peculiar conditions corresponding to the greatest intensities of action could always be fulfilled, this explosive would take rank with explosive gelatine itself instead of with gun-cotton for use under water.

General Abbot concludes that "rackarock possesses the merits of high intensity of action, unusual density, absolute safety in handling and storage (components unmixed), and little cost; on the other hand, under the conditions of my tests, an exceptionally strong detonating primer is essential to develop its full power."

Manchester Steam Users' Association.

At the monthly meeting of the Executive Committee of the Manchester Steam Users' Association, held at the offices, Mount street, Albert square, Manchester, on Tuesday, January 29, Mr. Alderman Schofield in the chair, Mr. Lavington E. Fletcher, chief engineer, presented his report, from which we learn that the Board of Trade have just issued their first annual report on the working of the Boiler Explosions Act, 1882, which extended from July 13, 1882, to July 13, 1883.

The Board of Trade report states that their engineer-surveyors have investigated and reported on 45 explosions, whereby 35 persons were killed and 33 others injured. The report attributes the explosions to the following causes: 14 explosions, killing 9 persons, to deterioration, corrosion, etc.; 5, killing 4 persons, to weak or defective design; 4, killing 10 persons, to over-heating through shortness of water; 4, killing 1 person, to the safety valves being insufficient or defective; 3, killing 3 persons, to undue pressure; 3, killing 1 person, to ignorance or neglect of the attendant; and 12, killing 7 persons, to miscellaneous causes.

The Board of Trade draws the following conclusions on the year's working.

1. The terms "inevitable accident" and "accident" are entirely inapplicable to these explosions. The reports show that so far from the explosions being accidental, the only accidental thing about many of them is that the explosions should have been so long deferred.

2. As in three cases only can the explosion be attributed to neglect or ignorance of management on the part of the boiler attendants, there is no reason for yet assuming that any material diminution in the number of explosions may be expected to result from the systematic examination of and granting certificates to the men employed in working the boilers.

The prevailing cause of explosions is the unsafe condition of the boilers through age, corrosion, wasting, etc.; and a noticeable feature in many cases is the absence of any effort on the part of the steam uses to ascertain the condition of the boiler, and consequently of any attempt on his part to repair, renew, or replace defective plates or fittings.

3. That inspection by insurers of boilers does not insure safety, for we find that one-fifth of the explosions which happened during the year happened from boilers not only inspected by, but insured in boiler insurance companies.

Mr. Fletcher points out that the conclusion that explosions are seldom due to the neglect of the attendants, but in the main to the unsafe condition of the boilers through age, corrosion, etc., shows that Mr. Broadhurst's Bill forbidding any one to tend a boiler who does not hold a Board of Trade certificate, which would be extremely harassing to the steam user, is unnecessary, and further, that it does not strike at the root of the evil. To this he adds, that there was nothing new in the facts brought out by the Board of trade report. They had been repeated by the Manchester Steam Users' Association over and over again, but it was satisfactory to find so impartial a judge pronouncing a sentence so entirely in accord with the views advocated by the Association for years.

THE NEW TAY BRIDGE.

During the past four months operations have been carried on at the Tay Bridge works almost without a break. The mild weather has been favorable for outdoor work on land, and the total absence of stormy, boisterous weather until within the last few days has allowed the difficult work of founding and building the piers to be proceeded with uninterruptedly for months past. The *Dundee Advertiser* gives the following detailed account of the actual work done on the bridge:—Commencing at the south side of the bridge, the brickwork of the landward abutment and No. 1 pier has been finished. Piers 2, 3, and 4 have also been built to a considerable height; but it is not intended to proceed much further with the brickwork of these piers till all danger of frosty weather is past. No. 5 pier—the first cylinder pier on the south side—is finished up to low-water mark, as also piers 6 and 7. These three piers have been sunk to an average depth of 14 ft. below the bed of the river. Each pier has been sunk two feet into the solid rock, and much time has been expended in making the excavations. The quarrying of the rock at such a distance from the surface of the water was a most laborious and exhausting operation. The work was carried on night and day until each pier was firmly set in its stone socket. The cylinders of pier 8 will be set in position in a few days.

The outermost pier on the north side is No. 54. This pier has been built to a few feet above high-water mark, and is at present undergoing the test required by the Board of Trade. A large number of square blocks of cast-iron, weighing in the aggregate some 800 tons, were three weeks ago piled on the top of the two cylinders, and workmen are at present engaged putting a like weight on pier 55. No. 54 has withstood the enormous pressure put upon it, and has been passed. Piers 54 to 71 incusive, forming the north-west curve of the bridge, are all ready for testing, and are embedded in the river to depths varying from 23 feet to 18 feet. The majority of the piers rest on foundations of hard gravel, while some are founded on rocky substrata. Pier 72 appears above low-water mark, and will be finished in a day or two. Two squads of workmen are employed on this section of the work—one working northwards and the other southwards—and a gap between piers 72 and 76 yet remains to be filled up. No. 76 is also above low-water mark, and No. 77 is ready for testing.

In preparation for the erection of the last brick pier on the north side—No. 78—the excavations have just been made, and the concrete foundation was to be completed last week. Pier 79 will be next proceeded with, and as a wooden coffer-dam has been found to be impracticable owing to the thinness of the clay bottom, the contractors have resolved to enclose the foundation of the pier by a coffer-dam of iron plates. Each of the plates is formed with an overlapping edge, and measures 13 ft. by 5 ft. In erecting the coffer-dam there will first be sunk guiding plates of the same length as the plates that are to form the walls of the dam, but much narrower. These guiding plates have overlapping edges corresponding to those of the principal plates. They are let down with their face—the side with the overlapping edge—inward. When they are in position the principal plates are dropped down with their faces outward, so that their overlapping edges will buckle into those of the guiding plates and form a continuous wall. The height of the wall will be 26 ft.; that is, there will be two of the 13-ft. plates on end to form the height of the wall. Pier 79 will be begun as soon as No. 78 is finished. Pier No. 80 is also of brick and is now ready for the copestones. It, along with the two other brick piers to the south, are to form a part of the extension of the Esplanade, and their shape has been designed to meet this end. Pier 80 is a "skew," its longest side measuring 50 ft. Piers 81, 82, and 83, founded on the rocks at Buckingham Point, are iron cylinders filled with concrete, and are finished.

The Messrs. Arrol have for some weeks back been engaged removing a portion of the old bridge at the west end of the Esplanade. The bow-string girder which connected the brick arches on the Esplanade ground with the bridge proper has been taken down, and as the new bridge deviates from the line of the old one after leaving the brick viaduct, it was found necessary to demolish the westmost arches. The brick pier—No. 84—built in line with the wall of the Esplanade, has also been removed, and, as the new bridge is to carry a double line of rails, a more spacious foundation of concrete has been laid down. Pier 85 will form the abutment of the viaduct, and from it to pier 84 a bow-string girder will carry the railway over the promenade on the Esplanade. The foundations of 35 of the 85 piers have thus been laid, and it is confidently expected that before another year all the piers will be founded.

At Wormit the contractors have a monster pontoon ready for launching. Its dimensions are 67 ft. by 81 ft. This pontoon or "quadruruped" will be fitted up exactly the same as the smaller ones. The "wells" through which the cylinders will be dropped are 25 ft. square, and a very powerful steam engine has been erected on board to work the pumps for supplying the hydraulic pressure. When launched the pontoon will be made fast to the old piers in the centre of the river, where the "legs" will be put in. The "legs" rest on a bell mouth 36 ft. in circumference, and they can easily be elongated to any height. Four capstans for mooring purposes have been fitted up on board. The Messrs. Arrol have the materials of another pontoon similar to the one at Wormit ready to be put together, and in a couple of months it also will be in operation. Four pontoons will then be simultaneously at work, so that rapid progress may be looked for during the current year. At present upwards of 200 workmen are engaged at the works, and a few more will be taken on as soon as all the pontoons are ready.

The placing of the girders of the bridge in position will be a work of some difficulty. The girders of the old bridge are to be utilized in the new structure. As soon as the brick arches at the south side are finished and the first two iron piers are carried up to the requisite height, the girder on the old bridge opposite the new iron piers will be slid across the intervening space on steel supports. When landed on the new piers the girder will undergo considerable alterations. The side sections will be taken asunder and placed on the east and west sides of the bridge. The sections will then be thoroughly overhauled and strengthened. When that is done the new girder will be run out and placed in position between the two sections of the old girder, and the whole will then be strongly fastened together by means of cross bars. Provision will thus be made for two lines of rails. The greatest engineering difficulty will be met when the long spans in the middle of the river are reached. Of course there are no old girders there to assist the contractors in their difficulty. The piers will be carried like the others to their requisite height

before any of the girders are placed in position. A temporary steel staging will then be hung from pier to pier, on the top of which the girders will be built. This process will be carried on till the gap is bridged over, after which the contractors will again take advantage of the standing girders on the north side up to the "skew" bow-string girder. To the uninitiated the difficulties which the engineers will have to surmount seem almost insuperable, but practical men speak with the utmost confidence of the ultimate success of the methods to be adopted in this second undertaking to bridge the Tay.

Imperial Standard Wire Gauge.

Below we publish a table drawn up by the Iron and Steel Wire Manufacturers' Association, showing the lengths, weights, and breaking strains of iron wire under the new rules which come into force on the 1st of March next.

IMPERIAL STANDARD WIRE GAUGE.

Table of Sizes, Weights, Lengths, and Breaking Strains of Iron Wire, issued by the Iron and Steel Wire Manufacturers' Association, England.

Size or Wire Gauge.	Diameter.		Sectional Area in Square Inches.	Weight.		Length of Hundredweight.	Breaking Strains.		Size or Wire Gauge.
				100 Yards.	Mile.		Annealed.	Bright.	
	in.	mm.		lb.	lb.	yds.	lb.	lb.	
7-0	.500	12·7	.1963	193.4	3404	58	10,470	15,700	7-0
6-0	.464	11·8	.1691	166.5	2930	67	9,017	13,525	6-0
5-0	.432	11	.1466	144.4	2541	78	7,814	11,725	5-0
4-0	.400	10·2	.1257	123.8	2179	91	6,702	10,052	4-0
3-0	.372	9·4	.1087	107.1	1885	105	5,796	8,694	3-0
2-0	.348	8·8	.0951	93.7	1649	120	5,072	7,608	2-0
1-0	.324	8·2	.0824	81.2	1429	138	4,397	6,595	1-0
1	.300	7·6	.0707	69.6	1225	161	3,770	5,655	1
2	.276	7	.0598	58.9	1037	190	3,190	4,785	2
3	.252	6·4	.0499	49.1	864	228	2,660	3,990	3
4	.232	5·9	.0423	41.6	732	269	2,254	3,381	4
5	.212	5·4	.0353	34.8	612	322	1,883	2,824	5
6	.192	4·9	.0290	28.5	502	393	1,544	2,316	6
7	.176	4·5	.0243	24	422	467	1,298	1,946	7
8	.160	4·1	.0201	19.8	348	566	1,072	1,608	8
9	.144	3·7	.0163	16	282	700	869	1,303	9
10	.128	3·3	.0129	12.7	223	882	687	1,030	10
11	.116	3	.0106	10.4	183	1,077	564	845	11
12	.104	2·6	.0085	8.4	148	1,333	454	680	12
13	.092	2·3	.0066	6.5	114	1,723	355	532	13
14	.080	2	.0050	5	88	2,240	268	402	14
15	.072	1·8	.0041	4	70	2,800	218	326	15
16	.064	1·6	.0032	3.2	56	3,500	172	257	16
17	.056	1·4	.0025	2.4	42	4,667	131	197	17
18	.048	1·2	.0018	1.8	32	6,222	97	145	18
19	.040	1	.0013	1.2	21	9,333	67	100	19
20	.036	0·9	.0010	1	18	11,200	55	82	20

January 15, 1884.

Metropolitan Sewage Discharge.

The first report of the Royal Commission on Metropolitan Sewage Discharge has been issued. It was appointed on June 22, 1882, and has limited its inquiry to two of the subjects laid before it. These are (1) the systems under which sewage is discharged into the Thames by the Metropolitan Board of Works, and (2) whether any evil effects result therefrom. The general conclusions are summarised by the Commissioners as follows:

"1. That the works of the Metropolitan Board, for the purpose of carrying the sewage of London to the respective outfalls at Barking Creek and Crossness have been executed in a highly creditable manner, and have been of great benefit to the metropolis.

"2. That the storm overflows allow the occasional discharge into the river, within the metropolis, of considerable quantities of solid fæcal matter accumulated in some of the sewers; but this has not caused, under present circumstances, serious damage or offence.

"3. That the sewage from the northern outfall is discharged, partly over the foreshore, and not, as was originally intended, 'through submerged pipes terminating below low-water mark,' this arrangement increasing the risk of nuisance from the discharge.

"4. That the discharge of the sewage in its crude state, during the whole year, without any attempt to render it less offensive by separating the solids or otherwise is at variance with the original intention and with the understanding in Parliament when the Act of 1858 was passed.

"5. That the discharge from the main outfalls becomes very widely distributed by the motions of the water both up and down the river, being traced in dry seasons through the metropolis and almost as high as Teddington; and that it oscillates for a long period before getting finally out to sea.

"6. That the dilution of the sewage by the land and sea water, aided by the agitation produced by the various motions in the river, effects a partial purification of the sewage by oxidation; and that this purification is carried further by the action of animal and vegetable organisms.

"7. That the sewage which becomes distributed to the higher and lower portions of the river thus gradually loses its offensive properties. The limits above and below the outfalls where this purification becomes efficient vary with the meteorological conditions, but it may be stated in general above Greenwich and below Greenhithe the river does not afford ground for serious complaint.

"8. That between these limits the effects of the sewage discharge are more or less apparent at all times.

"9. That in dry seasons the dilution of the sewage is scanty and ineffective, especially at neap tides.

"10. That it does not appear that hitherto the sewage discharge has had any seriously prejudicial effect on the general healthiness of the neighboring districts; but that there is an evidence of certain evil effects of a minor kind on the health of persons employed on the river, and that there may reasonably be anxiety on the subject for the future.

"11. That in hot and dry weather there is serious nuisance and inconvenience, extending to a considerable distance both below and above the outfalls, from the foul state of the water consequent on the sewage discharge. The smell is very offensive and the water is at times unusable.

"12. That foul mud, partly composed of sewage matter, accumulates at Erith and elsewhere, and adheres to nets, anchors, and other objects dropped into it.

"13. That sand dredged near the outfalls, which used to be obtained in a pure state, is now found to be so much contaminated with sewage matter as to be unusable, compelling the dredgers to go further away.

"14. That for these reasons the river is not at times in the state in which such an important highway to a great capital carrying so large a traffic ought to be.

"15. That in consequence of the sewage discharge fish have disappeared from the Thames for a distance of some 15 miles below the outfalls and for a considerable distance above them.

"16. That there is some evidence that wells in the neighborhood of the Thames are affected by the water in the river, and although there is no proof of actual injury due to the sewage that anxiety may be felt on that point.

"17. That there is no evidence of any evil results to the navigation of the river by deposits from the sewage discharge, but that this discharge adds largely to the quantity of detritus in the river, and so must increase the tendency to deposit.

"18. That the evils and dangers are likely to increase with the increase of population in the district drained.

"19. That it is desirable we should inquire further 'what measures can be applied for remedying or preventing the evils and dangers resulting from the sewage discharge.

"20. That before we proceed to this further branch of our inquiry we should allow some time for the consideration of this our first report, and of the remedies which may be suggested for the evils we have pointed out."

THE Hallowell Granite Co., of Hallowell, Me. are a present engaged on the National Monument to be erected at Yorktown, Va. They have just put into the slings one piece of stone 9½ feet in diameter and 9½ feet long, weighing some seventy tons. This huge piece of granite is to be cut into the drum or the beginning of the column, and on this will be carved in bas-relief thirteen allegorical figures representing the thirteen original States. Two experienced statue carvers employed by the company have the work in charge. This was originally intended to have been executed in four pieces. The company will erect this monument during the present year and have purchased a stick of timber 120 feet in length, straight grain Oregon, which they will use as the mast of the derrick to do this work.

COUNTY ROADS.—This subject seems to have become an interesting one in Virginia. Perhaps the frequent rains of the last two months have imparted to it an importance not previously attached to it. But we trust that such will not prove to be the case. We hope that the advent of good weather and the consequent "evolution" of passable roads will not have the effect of withdrawing public attention from the winter conditions of the roads.

We would urge that Albemarle be chosen as that central county which should be at once furnished with good roads, and thus take the friendly lead in the march of civilization and progress in Virginia.—*Richmond Despatch.*

SELECTED MISCELLANY.

THE Texas Pacific Railroad reservation has been surveyed by order of the State Land Board and it was found that the south boundary was placed four miles too far south, whereby a strip of land 180 miles long and four miles wide was improperly included in the reservation.

THE report of the town officers of St. Johnsbury, Vt., shows that the expenses of the past year were $29,500; cost of fair $2,700. The town adopted the cash tax system for highways last March and make a saving of $700 on the average expense of the past five years, while the highways have been kept in better condition.

THE copper production of the United States in 1883 was 96,150,000 pounds for the arts and 21,800,000 of argentiferous ores, which added to the stock from 1882 of 6,400,000 pounds, gives a total of 117,950,000 of which 41,850,000 were exported, leaving a consumption of 78,150,000. The product in 1882 was 99,062,000, and the export 5,850,000, leaving 93,212,000, for consumption in the year, less surplus, 6,400,000.

THE German Sanitary Commission sent to Egypt and India by the Imperial Board of Health of Germany to study the nature and causes of cholera has discovered cholera in the German water tanks at Calcutta, and found in a suburban village where cholera made its appearance the same microscopic organism which has been discovered in the lower intestines of cholera victims in Egypt.

VERMONT'S new corporation tax law has proven a failure, so far as providing the necessary revenue to meet the State's expenses is concerned. The statute was so carelessly drawn and passed by the Legislature that the railroads, instead of paying on their gross earnings per mile for the year, can only be taxed upon the amount of their gross earnings per mile for six months. This blunder it is said, was not discovered until some time after the bill became a law.

THE Paris correspondent of the London *Lancet* referring to the recent remarks in that journal as to the unhealthfulness of the mackintosh, gives M. Chieux's receipt for making cloths waterproof. It consists of steeping them in a solution of acetate of aluminium for a few minutes or until saturated. The cloth is then removed, and, without pressure or twisting, is hung up and exposed to the air for two or three days. The material—silk, wool, or cotton—thus becomes waterproof without preventing the escape of insensible perspiration.

A MEETING of the Suez Canal bondholders representing 25,000 shares was held the other day. It was unanimously resolved that the agreement made by M. de Lesseps with the British ship-owners was unacceptable. A committee was instructed to inform M. de Lesseps of this resolution. The bondholders admitted the necessity of a second canal. It was stated that Prime Minister Ferry had refused to open diplomatic negotiations on the subject, because the canal was a purely private work.

MR. W. F. ALLEN, the Secretary of the Railway time Convention, who devised the standard time system and secured its universal adoption by the railroads, has issued a circular to all companies asking for the names of towns (if any) on the lines of their roads which are not governed by standard time. His idea in issuing the circular is to ascertain officially the extent to which the standard time system has displaced local time. The general reports have indicated that the use of local time is extremely limited.

THE urban mortality in England for 1883 averaged 21.6 per 1,000, the lowest on record, and only 2 per 1,000 above the rate for the whole of England and Wales. The extremes are given in the rate for Bristol, 17.9, and Manchester, 27.6. The average in London was 20.4; Birmingham, 21.3; Nottingham, 21.3; Hull, 22.8; Sheffield, 22.9; Leeds, 23.3; Newcastle-on-Tyne, 25.5; Liverpool, 26.7. In the twenty-eight large towns the average rate for the principal zymotic diseases averaged 2.9 per 1,000, ranging from 1.0 in Norwich to 4.5 in Liverpool.

THE excavation of the St. Gothard tunnel cost many lives. On coming out of the tunnel the men described the sensation as being like a sudden plunge into ice cold water. The hot, humid air affected the digestive organs very much, and produced intestinal worms, which caused the death of a great number of workmen. Horses were similarly affected, and died rapidly. Several eminent doctors who studied these peculiarities pronounced them as being due to the want of aeration and the poisonous gases evolved from the blasting operations. And they reported that during the working hours the men were always in a high state of fever, which was succeeded, when the work was done for the day, by cold shivers and collapse. With these experiences to guide them, the engineers of the Simplon have necessarily made the question of ventilation one of serious and anxious study.

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CLARENCE W. LUNT, late of the firm of Hodges & Lunt, Civil Engineers, Boston, Mass., died at his residence in Boston Highlands, on the 22nd ult., at the age of 33 years.

FREDERICK H. ROBINSON, Chief Engineer of Wilmington, Del., in his annual report for 1884, complains that the sewerage of that city has kept pace neither with the times nor its own necessities; he hopes that the efforts made in the early part of 1884, which resulted in a plan and a report from Mr. Hering, Sanitary Engineer, may not be fruitless.

Less than 200 lin. feet of main sewer were built in the year covered by the report. This is a poor showing for a city of 42,500 inhabitants; the "naturally good surface drainage" referred to, does not meet the requirements of modern sanitary science.

High Service Water Supply for New York.

John Lockwood, hydraulic engineer, in a communication to the Commissioners of the Sinking Fund, argues that the city of New York can obtain all the advantages of the high service offered by the Ramapo scheme, at a much decreased cost. He says that the city has already a pumping station in operation at 97th St. and 9th Ave. and a stand pipe 245 ft. high above tide water; by increasing the height of the stand pipe to 300 ft. and the pumping capacity from 15 millions per day to 50 millions of gallons, all the advantages are gained that are offered by the Ramapo plan. Mr. Lockwood thinks this pumping can be done for $1,000 per diem, as against the $3,387.50 per diem for the Ramapo.

The same enlargement would hold good at the present High Bridge works and stand pipe, and 50 millions with a head of 340 ft. be provided from that point.

We give the above as it appears, whatever flaws there may be in Mr. Lockwood's proposition, if any, we leave to the discussion of those better posted in the complicated question of the much needed improvement of New York's water supply.

American Mining Engineers.

The American Institute of Mining Engineers elected the following officers for the ensuing year: President, James C. Bayles, of New York; vice presidents, Eckley B. Coxe, of Drifton, Pa., Thomas Egleston, of New York; Edwin C. Peshton, of Cleveland; managers, Edward S. Cook, Pottstown, Pa., Frank Firmstone, Easton, Pa.; C. W. Maynard, New York; treasurer, T. D. Rand, of Philadelphia; secretary, Rossiter W. Raymond, of New York.

Civil Engineers' Club of Cleveland, O.

At an extra meeting of the above club, held last Tuesday evening, J. F. Holloway in the chair. Mr. C. O. Arey read a paper on the "Construction of Frame Houses," and Mr. Edwin Martin's paper on "A Few Thoughts and Statistics on the Pumping Engine of the Period" was discussed. The Annual Meeting and Banquet of the Club, will be held on the second Tuesday in March, at the Windsor Club Rooms.

Expositions in Austria in 1884.

According to the *Moniteur Industriel*, the following expositions will be held in Austria during the present year:

At Vienna, in August and September, of machine tools and small motors, under the auspices of the Society of Artisans of Lower Austria.

At Krems-on-the-Danube, from the 2d to the 18th of August. This is purely industrial, and is under the patronage of the local administration.

At Steyer, in Upper Austria, of general industry, with an international section for electricity. This promises to be a very important exposition, judging from the present entries.

ENGINEERS' CLUB OF PHILADELPHIA.

Record of regular meeting, February 16, 1884.

Vice-President J. J. deKinder in the chair; 43 members and 6 visitors present.

Mr. Chas. A. Ashburner detailed his experience in the use of Aneroids in Levelling. He exhibited a collection of various forms of instruments and described their advantages and errors, and the means of correcting the latter, the graphical method being specially recommended.

The Secretary presented, from Mr. Edwin Ludlow, a description of the Exhaust Injector, with results of experiments therewith.

The Secretary presented, from Prof. J. A. L. Waddell, an illustrated paper upon Lateral Systems for Iron Pratt Truss Highway Bridges. The accompanying tabular data are based upon a lower than maximum wind pressure, upon the assumption that travelers do not venture upon highway bridges during gales of maximum velocity, and could not escape injury if they did, even if the bridge were proportioned as he considers railroad bridges should be, for maximum wind pressure when covered by a train. In the same connection the relative inconvenience of loss of highway and railroad bridges is also considered.

PERSONAL.

H. S. HAINES was elected Chief Engineer of the South Florida R. R. at last annual meeting.

MR. M. B. TEMPLE, chief engineer of the Gulf, Colorado & Santa Fe, has resigned that position.

THE Association of Surveyors and Civil Engineers of Michigan will hereafter be known as the "Michigan Engineering Society."

OLIVER EDES, the originator of the vast industry of machine rivet making in this country, and for many years past prominent in zinc manufacturing in Mass. and also connected with zinc mining enterprises in Virginia and Tennessee, died in Plymouth, Mass., on the 21st ult.

ERIE, PA., Feb. 20.—Capt. Wallace McGrath, formerly chief engineer of the Nickel Plate Railway, has resigned a similar position on the Ohio River Railway, and will take up his residence in Erie. The captain reports the damage done the Ohio Railway at only about $50,000, whereas reports had exaggerated the loss to a very much greater extent.

PRESIDENT WINSLOW, of the Ontario & Western Railroad, has issued a circular announcing the following changes, which will take effect March 1: The offices of Superintendent of Motive Power, Traffic Manager, Chief Engineer, and Engineer of Maintenance of Way are abolished. J. C. Anderson succeeds Henry Monett as General Passenger Agent.

MESSRS. BROWN & BROWN, Civil Engineers, Terre Haute, Ind., are the partners in an energetic young firm located as above. Both are graduates of Michigan University. One partner has had considerable practical experience on railroad surveys; the other has been connected with the U. S. Lake Survey, and with the N. Y. State Survey. They now solicit patronage in the general practice of their profession—railroads, drainage, land surveying, bridge designing, etc., etc.

AT a meeting of the City Council of Richmond, Va. on the 21st ult., an amendment to the City Ordinances increasing the salary of City Engineer W. E. CUTSHAW, from $2,125 to $3,600 per annum was offered by Mr. Todd, who said: "He hoped that it would be approved without a dissenting vote as a mark of deserved recognition of a faithful officer, an engineer of the highest order of talent, undoubted integrity, a gallant soldier, and a gentleman in the strictest sense of the term."

Mr. Barksdale and Dr. Cabell both approved the amendment in very earnest speeches, and commended the ability of Colonel Cutshaw as an engineer in the strongest terms.

The ayes and noes being called, the increase was agreed to unanimously.

At the same meeting the salary of Assistant City Engineer, Jackson Bolton, was increased to $1,500; also the salary of the Superintendent of the Pump-House to $1,500.

H. WADSWORTH CLARKE, the successful candidate for supervisor in the Eighth ward of Syracuse, N. Y., was born in 1837 in the town of Harford, Susquehanna county, Pa. He was brought to Syracuse when but eight months old and has lived there ever since, most of the time within the limits of the Eighth ward. Graduating at the Syracuse High School, he entered the city engineer's office as assistant in 1856. He was elected city engineer in 1864 and resigned six months after to take a commission in the 185th New York Volunteers with which he served until the close of the war. Upon his return, he was re-elected city engineer, holding the position until 1870. For the last six years he has been the engineer in charge of the re-survey of the boundry line between New York and Pennsylvania. He has been a member at various times for the last twelve to fifteen years, of the National Guard, in which he still holds the commission of Major. He is one of the earliest members of the G. A. R. in the city, and also belongs to the American Society of Civil Engineers, as well as to the Engineer's Club of Philadelphia, and the American Meteorological Society of New York. This is the seventh time that Maj. Clarke has been elected supervisor, which office he has held for a greater length of time than any member of the board ever elected in that city. Majority, 448.

MEXICAN NATIONAL (NORTHERN GENERAL DIVISION.)—President Wm. J. Palmer has issued the following circular: Mr. F. A. Lister, having tendered his resignation as superintendent, to take effect February 10, 1884, Mr. C. A. Merriam is hereby appointed superintendent of

the line from Corpus Christi to Saltillo, and of the Matamoros division, to take effect February 10. Mr. E. A Handy, engineer in charge, will take charge of the engineering and maintainance of way of all operated lines from Corpus Christi to Saltillo, and of the Matamoros division, reporting to superintendent Merriam. Mr. F. E. Butterfield, assistant engineer and superintendent Matamoros division, will report to superintendent Merriam. Mr. F. W. Baldwin is hereby appointed assistant superintendent of the line from Corpus Christi to Saltillo.

American Society of Civil Engineers.

FEBRUARY 6TH, 1884.

The Society met at 8 p. m. Vice-President Wm. H. Paine in the chair.

The deaths, on January 30, 1884, of John Avery, Mem. Am. Soc. C. E., and on February 2, 1884, of Prof. Charles A. Smith, Mem. Am. Soc. C. E., were announced.

Ballots were canvassed, and the following candidates elected:

As members—Henry Allen Brainerd, Palmyra, N. Y.; William W. Hegeman, Hudson, N. Y.; Charles F. Loweth, St. Paul, Minn.; Charles J. Morse, Youngstown, Ohio; Charles C. Schneider, New York City.

As associate—George G. McMurty, Pittsburg, Pa.

As juniors—Frank G. Darlington, Pittsburg, Pa.; Richard A. Hale, Lawrence, Mass.

A paper on "Water Power with High Pressures," by Hamilton Smith, jr., Mem. Am. Soc. C. E., was read.

For the purpose of supplying water to the placer mines in California, numerous ditches were constructed on the western slope of the Sierra Nevadas, and in many cases the mines having been exhausted or abandoned; the water is now used for power for various purposes, and it is probable that as manufacturing assumes larger proportions, much of the motive power required will be obtained from these ditches which in the aggregate would afford several hundred thousand horse-power.

The problem presented has been the utilization of a small quantity of water—few of the ditches carrying more than 70 or 80 cubic feet per second, with high heads ranging from 280 to 600 feet. Turbines have not given satisfactory results because the great speed due to the high head, resulted in excessive wear and tear. Partial turbines or tangential wheels had better success. In some cases large overshot wheels were built, one having a diameter of 65 feet. A wheel of a very simple form called the "hurdy-gurdy," was introduced some 20 years ago, and has almost superseded all other hydraulic motors. It has been improved from time to time and now gives an astonishingly high percentage of useful effects. As at first used, the "hurdy-gurdy" was a narrow wood disk fastened to a cast-iron spider frame; the faces of the large wheels being from 4 to 6 inches wide; the buckets being iron castings, and such wheels were built as large as 21 feet in diameter. These wheels cost little, required but light foundations, and when large, really acted as fly wheels. There was also nearly entire immunity from accidents. With the flat buckets, an efficiency of not more than 40 per cent. could be obtained. Daubisson describes somewhat similar horizontal wheels used in the Alps, the water being led to them by steeply inclined troughs. Probably the use of a jet escaping from a pipe is a California invention. The first improvement on these wheels was made by putting flanges on the side of the rim with curved sheet-iron buckets between. Useful effects of from 35 to 45 per cent. were obtained from these wheels; the best results being obtained with the use of comparatively large nozzles discharging the water. The next important improvement was what is known as the Knight wheel, made of cast-iron with curved buckets set close together, the nozzle being a narrow slip curved to fit the outer edge of the wheel, in order that the jet might strike the buckets as close as possible. An efficiency of from 54 to 65 per cent. was obtained from these. The wheel known as the Collins wheel, gave still more effective results, running up to an efficiency of 70 per cent. The latest so far used, is known as the Pelton wheel which has a bucket constructed so as to split the jet as it strikes the wheel; the bucket consisting of two sections of circles intersecting at the center of the wheel, and with convex surfaces presented to the jet.

Details of various experiments upon those wheels were given, showing an efficiency of from 82½ to 87 per cent. and the writer believes that with heads about 100 feet or even less, a large amount of work can be gotten out of water by the "hurdy-gurdy" than by any other form of wheel. Possibly water-pressure engines may give as good, or even better results, but their cost is very much greater. Where a wheel is so placed that it will at times be submerged, the turbine is preferable—in other respects however, the "hurdy-gurdy" possesses the advantage. A description was then given of the method of using water power for drilling the North Bloomfield tunnel in California, which was accomplished by the use of the "hurdy-gurdy" wheel.

The water was carried by a pipe main of single riveted sheet-iron, number 14 guage, in lengths of 20 feet, put together stove pipe fashion with the joints made tight by tarred cloth strips and pine wedges, the diameter of the pipe being 15 inches at the penstock, diminished to 7 inches at the lower end. The aggregate length of the main and branches was about 10,000 feet. The pipe was laid on the surface of the ground, the range of temperature being from 10 degrees to 107 Fahrenheit in the shade. Both the pumping, and the working of the diamond drills were done by the use of the "hurdy-gurdy" wheel. The head of water here averaged from 280 to 550 feet.

Descriptions were also given of the water power in use at the Idaho Gold Mines in California, where the supply main is of wrought-iron 22 inches in diameter, 8,700 feet long. The pipe is placed in a bath of boiling coal tar and asphalt before laying. This pipe is double rivetted, and has rivetted joints, the head being about 525 feet. Seven hurdy-gurdy wheels are employed driving air compressors, pumps, hoists and stamp mill. The power is transmitted by manilla rope at high speed. The writer also referred to the wrought-iron pipe used for the water supply of San Francisco, which had been laid for a number of years and seemed now to be in perfectly good order and without tubercles.

The paper was discussed by members present.

MEETING OF FEBRUARY 20, 1884.

The Society met at 8 p. m., Vice President Wm. H. Paine in the chair. John Bogart, Secretary.

A paper on Structural Steel, by E. B. Dorsey, Mem. Am. Soc. C. E., was read. The paper gave the results of an examination by the writer into the subject during two recent trips to Europe. The steel used for structural purposes is called generally in England, mild steel, and in Germany, homogeneous iron. Experts in Great Britain generally rely more upon physical tests and the reputation of the manufacturer, than upon chemical composition. The physical requirements are stated, and the manufacturer uses his direction as to the composition which will answer these requirements.

The rules for testing steel, adopted by the British Admiralty by Lloyd's Register, and by the British Board of Trade, were given. The tendency among English engineers is to use steel still softer than has heretofore been thought best. Some large builders use nothing in their boilers over 26 long tons tensile strength per square inch and 25 per cent. elongation in 8 inches. Others advise the use of steel of from 23 to 25 long tons tensile strength, with the same elongation.

American engineers require from 15 to 20 per cent. higher tensile strength than the English. The Siemens-Martin, or open hearth steel is preferred by nearly all experts for structural purposes, the Bessemer steel being principally used for rails. Ship builders are decided in their preference for the open hearth steel. A much larger number of plates would be condemned of the best wrought-iron than of steel. Data were given as to the loss of strength in steel plates by punching. Steel can be manufactured into much heavier, longer and wider pieces than wrought-iron. Steel rivets are used on the Clyde exclusively in riveting steel. The new Forth bridge is to be built of mild steel. The use of mild steel is extending very rapidly in Europe and has fast superseded iron for structural purposes.

The paper was discussed by the members present. During the discussion Mr. Theodore Cooper referred to the conservative stand taken by him in a paper presented to the Society some four years since, and expressed the opinion that at the present time he would feel still more conservative in regard to the use of iron instead of steel for structural purposes, particularly for bridges or similar constructions. For boilers, for ships, etc., steel has answered very well, but for structures he would be inclined as yet to advise the use of wrought-iron. In compression, in his opinion, steel has not been proved to be as strong as wrought-iron, and the necessity for most careful inspection is greater for steel than for wrought-iron.

Mr. M. N. Forney referred to the increasing use of steel for rails, for wheel tires, and for various parts of locomotive machinery. He referred to the records of accident which showed that some 66 per cent. of accidents in this country are due to derailment, and only 8 per cent. due to the same cause in England. In this country the number of broken wheels is very great, and the tendency toward the use of steel for tires is decided.

Vice-President Paine gave details of the methods of tests of steel in use during the construction of the Brooklyn Bridge, and expressed an opinion favorable to the use of steel.

The paper was also discussed by Messrs. Collingwood, Frith and North.

CORRESPONDENCE.

A MOUNTAIN RAILWAY.

Special Correspondence Engineering News.

ENGINEER'S OFFICE, C. M. & ST. P. RY.,
SIGOURNEY, IOWA, Feb. 15, 1884.

EDITOR ENGINEERING NEWS.—In reading a letter from one of your correspondents a short time since, I noticed that he considered the railway of which he wrote, as one upon which, in his opinion, are encountered steeper grades than upon any other railway in the country. This portion of his letter induces me to write of a portion of a mountain railway in Nevada, the location and construction of which I had in charge. The line of which I write is a short extension of the Nevada Central Railway, from the valley of the Reese river, up the Pony canon, through the city of Austin and nearly to the summit of the Toiyabe range of mountains. This extension is about 2¼ miles in length, in which distance there are employed over 40 different curves varying from a 2° to a 40° curve. The grades vary from level to 8 feet per 100 and in a distance of 10,300 feet, an elevation of 636.25 feet is attained. To overcome this elevation within the above distance, we were obliged to resort to one switch-back, and by this means, with a horizontal distance, at one point of 200 feet between centres of track we acquired a difference in elevation of 75.5 feet.

The use of such excessive curvature was made necessary by following an old wagon road, cut into the rock on the precipitous side of the canon. This line of railway was originally intended to be used as a tramway for the transportation of wood, charcoal and supplies from the end of the Nevada Central track, in the valley.

up to the Reduction Mills, etc., near the summit of the range, the motive power to be horses, but after the line was constructed the Nevada Central railway moved their depot from the valley up into the city at an elevation of 403 feet above their original location, and since that time have hauled their freight and passengers up this heavy grade directly into the city.

The engines used were constructed specially for this work and are well adapted to steep grades and abrupt curvature. Before beginning the construction of this line, we made some experiments upon the load that can be hauled upon a track by horses, on a grade of 8 feet in 100, the result of which may be of interest to engineers. We constructed a short portion of road as follows: About 200 feet of road with level grade; immediately following that, about 150 feet of track on an 8 feet to the 100 grade and 100 feet of level at the summit. We loaded a narrow gauge box car (ordinary weight) with 16,000 pounds, and attaching 6 horses they drew the loaded car easily to the summit. We then let the car back and stopped it on the grade. The team started it from this point and drew it to the summit. We then removed two of the horses, and repeated the entire experiment with but four, and with perfect success, although it taxed their strength severely. Considering, however, the fact that their footing was poor, owing to the surface of the bank being soft and yielding, as compared with the hard surface of the ties, which conditions were most unfavorable for heavy pulling, I am of the opinion that upon a uniformly hard footing, four horses could have hauled an additional ton of weight up the same grade as easily as they performed what they did.

The tramway idea, however, as I previously intimated, was abandoned shortly after the completion of the road, and at present steam is the motive power used. I think that, considering the resistance of the curvature on this line, that it encounters the steepest grades of any road now in operation in this country, upon which steam is used, applied to friction. There may be roads where gearing or a similar device is employed in overcoming heavier grades than those that I have mentioned.

Yours truly,

F. E. HOUSE, C. E.

CANADIAN PACIFIC RAILWAY.

Special Correspondence Engineering News.

OTTAWA, Feb. 26, 1884.

EDITOR ENGINEERING NEWS.—I notice in your issue of Jan. 19, a communication from your Ottawa correspondent to the effect that the work on the Canadian Pacific Railway in British Columbia is being very imperfectly done. Now, this is entirely incorrect and your correspondent could very easily have ascertained that it was so if he had wished to do so. I don't suppose for a moment that you have any desire to put abroad a false statement, and in order to enable you to correct your correspondent's erroneous statement, I send you a copy of the Government Engineer's Report upon the work. He made a very thorough examination late in summer. The *decay* of the wharf that your correspondent refers to was caused by the ravages of the sea worms and will be remedied by the substitution of iron screw poles as recommended by the chief engineer.

Yours truly,

EDWARD C. BARBER.

REGULATION OF WESTERN RIVERS.

Special Correspondence Engineering News.

SO. FARMINGHAM, MASS., Feb. 25, 1884.

EDITOR ENGINEERING NEWS.—Your correspondent "T. L. M.," in issue of 23, offering suggestions relative to impounding the surplus waters of the tributaries of Ohio river by a series of dams, has been simply following in the footsteps of Col. Chas. F. Ellet, who gave the subject a very great deal of study and a thorough investigation a few years before the war of the Rebellion, diverted his attention from it, ending with the sacrifice of his life in the effort to aid in opening the Mississippi river. Had he survived, it is likely he would have applied his masterly abilities in that direction. The plan seems most applicable to the rivers of West Virginia and Eastern Kentucky, where land damages would cut a slighter figure than in Ohio. To make the reservoirs most effective in reducing floods they must be ordinarily kept at a low stage, to provide the greatest possible amount of storage in time of floods, hence they would have but slight value as water powers.

L. W. DINSMORE.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.; M. INST. C. E.

(*Continued from page 91*)

DXCVIII—WHITESBORO, N. Y.

Whitesboro (Whitestown P. O.) Oneida Co., New York, in lat. 43° 40′ N., long. 75° 20′ W.; is on the Sanquvit Creek. Settled in 1814, it was incorporated a village in 1830.

Water-works were constructed in 1821 by Lyman L. Wight, as a private enterprise. The water of a number of springs is collected in a tank of masonry, 20 by 15 feet, and 8 feet deep, on ground 31 feet above the village.

The water is distributed by 2½ miles of pipe, of 4 and 3 in. diameter. Cement pipe was first used; when this failed, wooden pipe was substituted, and since the failure of this cast iron has been used with satisfaction. There are no fire hydrants, 2 gates and 32 taps. Service pipes are of wrought iron.

The population in 1880 was 1,200. The daily consumption is not known. The works have cost $3,500. The receipts in 1883 were $300, and the expenses merely nominal. The works are owned by Lyman L. Wight.

DXCIX—MECHANICSBURG, PA.

Mechanicsburg, Cumberland Co., Pennnsylvania, in lat. 40° 10′ N., long. 77° 30′ W., is in a broken country. It was incorporated a borough in 1826.

Water-works were built in 1857 by a private company after plans of Messrs. Irish & Ginnis, taking the supply from springs, draining an area of about 2 square miles, about 3 miles from the town. One spring issues from limestone and the others from slate rock. The water of the springs is collected by 1½ miles of tile pipe leading into a reservoir 218 by 85 feet and 6 feet deep. At the outlet of the reservoir the water is strained through 5 sheets of galvanized iron, 4 by 2 feet, perforated with ¼ inch holes and set 15 inches apart in a wooden trough. From the strainer box it flows through a tunnel 3 feet wide, 6 feet high, for 700 feet through slate rock, and then 600 feet through a 6-inch cast-iron pipe fitted with a copper strainer, to a reservoir 70 by 80 feet and 15 feet deep, made by an earth dam across a ravine. The sides are lined with a wall of small stones laid dry to admit the water from the adjoining soil which is full of springs. The supply pipe to the town, 2¾ miles, was first of 6 inch diameter, but 1,000 feet of this has been replaced by 10-inch pipe. Distribution in the town is by 2 miles of 6, 4 and 2-inch pipe, with 23 fire hydrants, 21 gates and 500 taps. Service pipes are of galvanized iron and lead. The borough pays $250 per year for hydrants.

The population in 1880, was 3,018. The daily consumption is not known. The company also controls the gas works. The capital stock for water-works is $25,000, and the bonded debt $15,000, at 5 per cent. interest. Improvements in the water-works here have cost $3,000. The expenses of maintenance are about $600 and the receipts from water rents $3,900. The 2-inch pipes in the streets are being replaced by 4-inch. The water rates are revised annually by the company. George Hunt is President, J. C. Bauman, Secretary and Treasurer, and Andrew Seifert, Superintendent.

DC—LA PORTE, IND.

La Porte, Indiana., in lat. 41° 35′ N. long. 86° 40′ W., is on a high plateau on the border of Clear Lake, one of a chain of seven small lakes, 7 miles long and 4 miles wide. Settled in 1830, it was incorporated a city in 1852.

Water-works were built by the city in 1870 by the Holly Manufacturing Co., taking the supply from the lake at a point where there is 40 feet depth of water, through a wooden 16-inch suction pipe, 800 feet long, and pumping directly into the mains by six piston pumps 12 by 12 inches, geared to a shaft driven by a Holly steam engine. There are two rotary pumps for fire protection. The ordinary pressure is 35 pounds and the fire pressure 100 pounds. Distribution is by 18 miles of cast-iron pipe of 12 to 4 inches diameter, with 92 fire hydrants and 32 gates. The number of taps is not given. There are 14 meters in use. Service pipes are of galvanized iron and lead. The population in 1880 was 6,195, and is now said to be 8,000 and the daily consumption 350,000 gallons. The works cost $152,000. The total bonded debt is $80,000 at 7 per cent. interest. The expenses in 1883 were $6,000 and the receipts $6,800. The works are managed by three Trustees. George H. Storey is the Superintendent.

NOTES.

There is a constant demand for the completion of the book and a call for another issue of the tables published last year. It is the author's desire to have the book as nearly perfect as possible before putting it forth in separate form, but there are a number of works the managers of which neglect to reply to letters asking for information. Besides the places alluded to last week, (viz. Mobile, Newburyport, Canton, O.; Austin, Tex.; Chillicothe, O.; Shenandoah, Pa., Columbia, S. C.; Knoxville, Tenn.; Jeffersonville, Ind.; Elgin and Ottawa, Ill.; Danville, Va., and Michigan City, Ind.) the following places are remiss in furnishing information and any person who knows anything about the water-works in them is earnestly requested to communicate with Mr. J. J. R. Croes, 63 Bleecker Street, and blanks for information will be furnished: Columbus, Ga.; Portsmouth, N. H.; Columbia, Pa.; Shamokin, Pa.; Hazleton, Pa.; Massillon, O.; Windsor, Ontario; Galion, O.; Port Hope, Ontario; Dunmore and Kittanning, Pa., and Geneseo, N. Y.

WATER.

WE are indebted to several correspondents for information concerning water supply; we beg leave to express our thanks for their kind courtesy and hope it will be emulated from all over the continent. We take a large list of the best news-gathering dailies, from which to select notes of value to our patrons, but there are water-works being projected everywhere throughout the Union, and unless we have some co-operation by our readers, we can get intelligence of but a portion of them. In the general interests of the engineering and contracting community, we earnestly solicit correspondence, marked papers, reports, etc., on subjects relating to this department.

A NEW artesian well at the Joliet, Ill., penitentiary is down to a depth of 2,319 feet—nearly a half mile—and it emits a stream of 150 gallons a minute. At first the water had a milky appearance and strong salty taste, but now the water is as clear as spring water, but has a decided citric-acid flavor.

MARYSVILLE, Dakota, wants an artesian well.

CINCINNATI TABLE WATER.—Said a guest at one of the Cincinnati hotels, last week: "Waiter, bring me some water."

"Did you say watah, sah?" said the waiter.

"Yes, water—bring me a glass of water."

"What age, sah, and what flavah, sah? We have some very fine watah one year old, or, if you prefer, sah, we have it but a few days old. We have the Big Sandy flavah, Kanawha, Scioto, Bull Skin Creek, Little Miami, Licking, Millereek, Valley or canal.

POTTSVILLE, PA., Feb. 25.—A company was formed last Summer for the purpose of supplying Girard and the collieries hereabouts with water, they having suffered severely during the summer droughts of the last two years. The ground selected for the site of the reservoir and the stream proposed to be appropriated were on the lands of the Girard estate, owned by the City of Philadelphia, and were contested by another company. Viewers were appointed to assess the damages to the estate, and they appraised it at $25,000. The Court yesterday entered a judgment for the amount stated, and in favor of the City of Philadelphia. The Girard Water Company, it is understood, will accept the terms and proceed at once with the construction of the work.

THE committee on water supply, Massachusetts Legislature, have reported bills incorporating George A. Parker and others as the Lancaster Water Company, with leave to take water from Spectacle Pond, with a capital stock not exceeding $50,000; Waldo F. Ward and others as the Hyde Park Water Company, with a capital stock not exceeding $200,000, and leave to take water from the Neponset River; the Sunderland Water Company with a capital stock of $10,000; also a bill authorizing the town of Clinton to increase its water debt by the issue of bonds to the amount of $50,000; the committee also gave a hearing on petition of the town of Waltham, that it may take and use for domestic purposes the waters of Stony Brook. Chas. H. Friske, Esq., counsel for the town of Weston, asserted for his clients that they have the first right, and that it should not be alienated from them. Mr. J. W. Hammond, City Solicitor of Cambridge, opposed any legislation which will prevent his municipality from securing by amicable or equitable arrangement water from this source.

THE Government has had an analysis made of the water used for domestic purposes at Kingston, Ont., and finding that it needs purifying have secured from New Jersey a $1,400 sand filter.

THE town of Berryville, Va., is contemplating the erection of water-works on the plan of those erected at Westminster, Maryland. The bill to bond the town has passed both houses of the Legislature. Preliminary surveys and estimates have been made for the work by Messrs. Baylor and Baylor, civil engineers, of 7 Broad St., Atlanta, Ga. A correspondent of the Richmond *Dispatch* says: "The town Councils seem to have caught the spirit of progress, and is investigating as to the cost and expediency of water-works. It is to be hoped that a few old fogies will not be able to prevent this much-needed improvement, for last fall we were threatened with a water-famine. Our streets are already lighted and well-paved, so that Berryville looks like an amateur city."

Canvas of bids for cast-iron water-pipes for the Boston Water-works, received Feb. 19, 1884.

QUANTITIES.			W. H. Thomas,* Philadelphia, Pa.	R. D. Wood & Co., Philadelphia, Pa.	Warren Foundry and Machine Co., Phillipsburg, N. J.	Gloucester Iron Works, Gloucester, N. J.	Mellert Foundry and Machine Co., Reading, Penn'a.	A. H. McNeal, Burlington, N. J.
20 tons	4	in. Class B	34.75	37.25	34.40	35.00	38.40	39.25
500 "	6	" "	34.75	37.25	34.40	35.00	36.40	39.00
210 "	8	" "	34.75	37.25	34.40	35.00	35.40	39.00
330 "	12	" " A	34.75	37.25	34.40	34.50	34.40	38.00
420 "	12	" " B	34.75	37.25	34.40	34.50	34.40	38.00
150 "	Spec'l castings		58.80	37.25	67.20	69.00	65.00	70.00
TOTALS			$60250	60717	60992	61775	62102	67475

The prices are per ton of 2240 lbs.

*Contract awarded.

WATER METERS.—Before the Massachusetts House Committee on the Judiciary is an order relative to the expediency of legislation to regulate the use of water meters by cities and towns and for the better protection of the rights of consumers of water as well as those of the cities and towns adopting water meters. It was presented by Mr. Farrell, of Boston, and a hearing under it was held on Tuesday last at 11 a. m. In regard to that legislation which is looked for by his order, Mr. Farrell makes these suggestions:

First—Every water meter should be inspected, examined and proved by a board of competent men well versed in mechanics and hydraulics or by an inspector appointed in the manner provided in Chapter 61 of the Public Statutes. [This chapter provides that the Governor, with the advice and consent of the Council, shall appoint an Inspector of Gas Meters, who shall give a bond of $5,000 for the faithful discharge of the duties of his office.] It should be the duty of the Board or Inspector to ascertain the accuracy of each meter in measuring and weighing the quantity of water to be furnished to or for the use of any person, establishment, etc.

Second—Every meter tested should be stamped and sealed with some suitable device, certifying to its accuracy.

Third—The Board or the authority charged with the inspection of meters should not be interested pecuniarily in the manufacture or sale of water meters or any article or commodity used for any purpose connected with the consumption of water, or with any person or company manufacturing, in whole or in part, water meters; neither should they give certificates or written opinions to a maker or vender of any such article or commodity.

Fourth—Every inventor, or person, or corporation owning or controlling any invention or mechanical device for measuring and weighing water should have the right, upon application to the Board or Inspector, to have such devices and inventions tested in their presence or in the presence of some representative selected by them, and public tests shall be provided for before any water meter shall be adopted by any water board or commission, or by any City Council or Board of Selectmen in any city or town.

Fifth—In the examination and testing of a meter the Board or other authority should see that the meter is of an approved principle and standard, and should give particular attention to the measurement of dial plate and the device for measuring and weighing water. It should prove the meter when *set level*, and if any meter varies in any respect from the standard measure, the variance should be correctly written out and be open to public inspection.

Sixth—Any person who wilfully injures or suffers or causes to be injured any meter, or any portion of any of its mechanical devices, or its fittings, or interferes with its proper action, should for every such offence be punished by fine or imprisonment, or both.

Seventh—It should also be provided that no member of a Board of Selectmen in towns, nor members of a Water Board or Commission of a City Council, shall have any pecuniary interest, direct or indirect, in meters; and penalties for violation of such provisions of law should be provided.

HOPKINSVILLE, Ky., will build water-works.

THE Lincoln Water-Works Company of Lincoln, Ill., was incorporated on the 23rd ult. capital, $100,000: incorporators, Henry W. Dana, Ambrose M. Miller, Colby W. Knapp, Abram Mayfield, and A. C. Boyd.

MR. ALPHONSE FTELEY, late Principal Assistant City Engineer of Boston, Mass., has removed to New York to assume his duties as "Executive Engineer" of the new Croton Aqueduct, with his office in the Tribune Building.

THE Bridgeport, Conn., Water Company has awarded the contract for making and laying a 24-inch main to the Connecticut Patent Water Pipe company, of New Haven. The pipe will be the Phipps hydraulic pipe.

WE chronicled in the last volume of ENGINEERING NEWS the stoppage of water pipes by eels; we are in receipt of an illustration of a patent "service cock," invented by Walter S. Payne, of Titusville, Pa., designed to put a stop to the "insinuations" of these slippery nuisances.

MR. LUCIUS J. KNOWLES, aged 65 years, the inventor of the Knowles steam pump, and the Knowles power loom, one of the wealthiest and best known manufacturers of Worcester, Mass., died suddenly of neuralgia of the heart, at the Riggs House, Washington, D. C., on last Monday evening. He left home on Friday previous with his wife, on a brief pleasure trip, and was at that time apparently in his usual health. He was a director in various financial and educational institutions in Worcester county, and had been a member of the Massachusetts State Senate.

PITTSBURG, Feb. 25, 1884.

EDITOR ENGINEERING NEWS.—I see by your issue of Feb. 23, 1884, that the Philadelphia Water Department after some months investigation have ordered the Payne Tapping Machine. I wish you would state in same column under "Water," that the department also ordered an equal number of machines of the A. Letzkus design, of Geo. R. Harlow, Agent, 81 Wood street, Pittsburg, Pa. These two designs, I understand, were the only ones taken out of six offered.

Respectfully,
GEO. R. HARLOW.

AN ENGINE WHICH SAVED CINCINNATI FROM A WATER FAMINE.—There is a great diversity of opinion among engineers and mechanics, not only of this city, but of the whole country, as to the merits and demerits of the big hydraulic machine at the Water-works, known as the Shield engine. No matter how good she may be, or even how bad (and there are many who would be almost willing to pronounce her worthless), she has responded to a timely call on at least two occasions of emergency, viz: during the flood of 1883, and again during the present month. The Shield was the last to give out and the first to resume, and with her aid, to the extent of five hundred thousand gallons per hour, a water famine was prevented. With a suction power of nearly 60 feet and a forcing power of 250 feet, she took water from the intakes of the works in the Ohio River and forced it to Eden Park, a distance, perpendicularly speaking, of more than 290 feet.

This mammoth piece of machinery was named after its inventor, who for many years was the engineer of the City Water-Works. While engaged as regular engineer, Geo. Shield drew the plans and perfected the specifications for one gigantic work. He lived to see it in working order, but not to realize its immense working power. Shortly after the ponderous engine was completed Mr. Shield was removed from his position. He became disconsolate and gloomy, and it may be truthfully said died of a broken heart.

Now a few words as to the history of this wonderful machine. The plans, as originally drawn, were for a twenty-four million gallons per day pumping engine, and were submitted to the Trustees of the Water-works on November 15, 1860. The estimated cost at that time was less than $82,000. The plans were approved and patterns ordered to be made. In February, 1861, the plans having been completed and the work properly advertised, the contract for all iron castings was awarded to what was then known as the Niles Works at 3¾ cents per pound.

The work proceeded slowly and the expenses ran up rapidly—so fast, in fact, that on January 1, 1867, the books of the office showed that $360,000 had been expended on the work. In addition to this $50,000 was expended for the Wilson valves, boilers and alterations. The force main of the structure was made of ⅜ inch boiler-iron 50 inches in diameter and 632 feet in length, 172 feet being laid in a tunnel or viaduct. It was subsequently found that the strain was too great, and they were taken out, a cast-iron ship-joint with wrought-iron braces being substituted.

The cylinder of the engine is 100 inches, or 8 feet 4 inches, in diameter, and 12 foot stroke, and weighs 37,926 pounds. It was bored in the pit in which it was cast. The piston-head weighed 12,366 pounds. The total weight of the castings for engine and pump was about 900 tons. The steam cylinder, as already said, is 100 inches, the pump cylinder 46 inches, the air pump 32 inches. The pump main to the old reservoir on Third street is 750 feet; to the new reservoir, 3,300 feet. The present available capacity is 12,000,000 gallons per day.

No matter what may be said of this engine, it can be truthfully stated that it played its part nobly in two cases of emergency.—*Cincinnati Enquirer.*

CHIEF ENGINEER CANBLIN of the Philadelphia Fire Department says that engines might just as well hitch to lamp-posts as to such plugs as are located in the immediate vicinity of Broad and Vine Streets.

THE Brainerd, Minn., Water-Works Company has made a final test of the pipe with a pressure at 250, with the best of results. A stream of water can be thrown over the steeple of the Catholic Church, the highest building in the town.

CITY ENGINEER THOS. TOSTEVIN reported Feb. 21, to the City Council of Council Bluffs, Iowa, regarding the test of the city water-works. The report was received and placed on record by the clerk, and the following resolution unanimously adopted:

Resolved, That the official test of the Council Bluffs City Water-Works Company's water-works, held Feb. 21, 1884, is satisfactory, and that the same and the company's works as constructed and now in successful operation in the city, are in accordance with the requirements of the company's contract therefor, and as such are hereby accepted, and the Mayor is directed to officially notify the company of the acceptance thereof by the city.

Harry Birkinbine is chief engineer for the Water-Works Co.

The cost of making house connections with the water mains in Council Bluffs is as follows, payable in advance:

½-inch Service Pipe	$ 8.25
⅝-inch Service Pipe	9.50
¾-inch Service Pipe	10.75
⅞-inch Service Pipe	13.25
1-inch Service Pipe	15.00

These prices include the cost of opening and closing the street, tapping the street water main, furnishing and putting in extra strong lead service pipe, furnishing and putting in curb stop, stop box and cover complete, and making all necessary connections between the street water main and the curb of the street, which are about one-half the cost to the consumer of doing the same work.

IN the case of the City of Pittsburg *vs.* Andrew Hartupee *et al*, concerning pumping engines a verdict was awarded the plaintiff on the 21st ult., at Beaver, Pa., for $375,000, the full penalty of the bond, to be released upon the payment by the defendents to the city of the sum of $190,240. The Pittsburg *Dispatch* says editorially "It is necessary to notice too that this decision amounts to a practical vindication of the Mechanical Engineer. After years of opposition and enmities which were probably heightened by his own eccentricities, Mr. Lowry comes out on top, and few impartial observers will regret that his faithful services to the city are thus endorsed."

AUGUSTA, Ga., Feb. 26.—The city of Augusta to-day voted a tax of one-quarter of 1 per cent. on the city property, valued at about $25,000,000, for the purpose of extending the sewerage of the city. This is rendered necessary for the health of the city and to accompany the improved water-works just contracted for. Augusta is erecting improved buildings and making river improvements, and has sent a delegation to Washington to urge an appropriation of $300,000 from the latter work.

THE bill authorizing the city of Brooklyn to get an additional supply of water from Queens county was passed by the N. Y. Legislature on the 22nd. Mr. Otis tried to get it delayed for further hearing, but the Lieutenant-Governor by his casting vote decided for the immediate passage of the bill, and all further arguments against the measure will have to be made before the Assembly Committee.

MILWAUKEE, Feb. 26.—A big kick is being raised by Eastern capitalists because the city proposes to call in 5 per cent. of the water bonds issued between the years 1872 and 1874. The total issue was $1,600,000. The first bonds of the issue were called in last year, the amount redeemed being $76,000, leaving $1,524,000 still outstanding. It is now proposed, in compliance with law, to call in a like proportion of the bonds on the first of next June. Many of the holders maintain that as no right is reserved in any of the bonds to redeem prior to the year 1902 none of the bonds can be redeemed before that time. The bonds are drawing interest at the rate of 6½ and 7 per cent. A large number of the bonds are held in Boston, and the holders propose to contest the right of the city to redeem them and a big suit will follow.

QUINCY, Mass., Feb. 22.—To-day the new hydrants of the Quincy Water Company were tested under the direction of the Board of Engineers. The trial proved a most satisfactory one. Four lines of hose were laid from the hydrant in the square and water forced to a height of seventy feet. Trials in other sections of the town proved the efficiency of the service to the satisfaction of the town officials.

A MEETING of the stockholders of the Artesian Water Supply company was held at the office of H. C. King & Co., on yesterday afternoon. The special object of the meeting was to vote on the question of amending the articles of incorporation so that the company shall have the authority to sell water to parties who wish to purchase it, even though they are not stockholders. The stockholders present voted unanimously in favor of the amendment. The company will push matters right along until a sufficient flow of water is obtained.—*Denver (Col.) Tribune*, Feb. 19.

UPWARDS of 1,000 cubic yards of mud has been removed f the forebay at the Fairmount water-works.

A 9-INCH water main, to cost $35,100 is to be laid along Ninth St., Philadelphia. Chief Engineer Ludlow is authorized to introduce electric lights into the Spring Garden Works to take the place of gas now used. Last year's gas bill was $2,419.30. The annual cost of the electric light will not exceed $1,200. Colonel Ludlow is authorized to invite proposals for building two steel boilers at a cost of $6,500 each, for the Spring Garden works to take the place of two boilers removed to the Roxborough works.

THE Little Falls Water Power Company, of Minnesota, filed articles of incorporation recently, the nature of its business being the improvement, development and use of the water power of the Mississippi River at Little Falls. The office of the company is to be located in St. Paul and its capital stock is $500,000. The incorporators are: Charles A. DeGraff, Lyman L. Hodge, Henry P. Upham, Milton M. Williams and William Crooks, all of St. Paul.

A BORDER FINANCIER.—At El Paso Mexican dollars are worth eighty-five cents in American coin. At Paso del Norte, just across the river, American dollars are worth eighty-five cents in Mexican coin. One morning a cardriver started from the American side with a Mexican dollar. On his arrival at the Mexican town he took a drink of "chained lightning," which was fifteen cents, and received an American dollar in change for his Mexican. On his return to the American side he took a drink of equally bad liquor and received a Mexican dollar for his American, and so repeated the drinks at intervals during the day, and at night he closed up business with the Mexican dollar he started with in the morning.

ABOUT ten years ago Piqua, Ohio, to counteract the loss of her old-time commercial prestige, constructed an extensive hydraulic system, costing between $350,000 and $400,000. It is probably the finest hydraulic water power in Ohio, if not in the West. In connection with it is a most admirable system of water-works. The work was completed in 1875. For several years its anticipated effect upon the good fortune of the town was not realized, and the census of 1880 shows that Piqua had made little headway in the decade which ended with that year. But in 1881 the long-expected boom came, and wrought a wonderful change in the ancient town. Large manufacturing establishments sprang up —paper mills, steel works, furniture factories, wagon factories, and other establishments—and the town underwent a metamorphosis. The prosperity was wonderful, and continues so to this day. While shops in other Ohio cities are closed or running short-handed, the Piqua establishments are all in operation to their full capacity and some of them running extra time at night.

NEWS OF THE WEEK.

Streets, Drainage, Sewerage, Etc.

SEVERAL miles of stone pavements are to be laid this year in Cleveland, O.

A BILL authorizing the city of Lynn to borrow money for the construction of drains and sewers, has been referred to committee.

IN East Saginaw, Mich., cedar for paving costs, delivered, from $3.00 to $5.00 per cord; stone from $8.00 to $10.00 per cord; Medina curbs 32 to 36 cents per lineal foot.

THE village of Little Falls, N. Y., intends to building sewers in Ann, Monroe, Lansing, Garden and Jackson streets, in all about 6,600 feet. C. F. Carpenter has been engaged by the Trustees of the village to prepare the plans and estimates of cost. The construction of the sewers will be begun as soon as practicable, in the spring.

PIQUA, O. February 21.—The long talked of new city building for Piqua is to be erected this year, a conclusion to that effect having been reached by the City Council at the meeting held last night. The building contemplated will be the finest of the kind in the State.

IN the Kentucky Senate on the 22nd ult., six turnpike charters were granted and as many more amended. House bill, by Mr. Thompson, of Hamilton directing the Commissioners of Hamilton County to improve Fleming avenue, between Wyoming and Mount Pleasant, at a cost of $30,000, was introduced.

TORONTO MAIN DRAINAGE.—The City Council have approved of a scheme proposed by Alderman Turner, chairman of the Board of Works, to issue permanent debentures for the sum of one and one-half millions, for the purpose of carrying out this work. City Engineer Sproatt is very busy preparing the necessary details. Mr. Rust, Asst. Engineer, is taking levels east of the city in connection with this work, and in all probability some portion of this much needed improvement will be commenced next year.

IT is estimated that 2,000 persons left Jamaica during January to seek employment on the Panama Canal.

TORONTO, CAN., CITY IMPROVEMENTS.—Last year there were constructed 12.75 miles of cedar block roadways; 9.67 miles of new sewers (making a total of 95 miles of sewers in the city); and 22.25 miles of wooden sidewalks. The total expenditure by the committee on works, amounted to $756,876, an increase over last year of $356,396. W. Page has completed the retaining well on Yonge street at the Tannery Hill, the cost of the same being $7,000. This work has been, owing to the intense cold, and the small space in which to work, one of great difficulty.

AN impression of the seal of the Bushnell Highline Ditch and Reservoir company has been filed.

Articles of incorporation of the Hardin Dit h company have been recorded with the Secretary of State; $20,000 form the capital stock and George H. Hardin, James D. Potter and Obediah C. Smith are the Directors.

Articles of incorporation of the San Jose Ditch Association were filed with the Secretary. The capital stock is to be $2,500, and the Directors for the first year are Jose A. Salazar, Antonio C. Gutterey and Pedro Salazar.—*Denver Tribune.*

BOSTON, Feb. 27.—An interesting question is before the Committee on Improved Sewerage involving the ownership of Moon Island and Squantum. The City Engineer has found it necessary to establish another pumping station at Squantum, and reported in favor of taking land for that purpose. Both Squantum and Moon Island are owned by Paul Butler, son of the ex-Governor, who has already received $10,000 from the city for the use of Moon Island. Gen. Butler has appeared before the committee with the following propositions, which are taken under advisement: First, to grant enough land in Squantum for a pumping station for $10,000; second, to grant four and one-half acres for $21,000; third, to grant all but the ground on which the hotel stands for $45,000; fourth, to grant a fee of the whole for $60,000. Squantum cost the Butler family $30,000.

To contractors who are using large quantities of cement, and to cement pipe manufacturers, a saving of twenty-five cents on one barrel of cement is a "big item." This saving has been made in England and on the European continent for many years, by using bags instead of barrels, as in this country. The average cost of a Portland Cement barrel is 25 cents and after use they are unsaleable by a contractor at a distance from a cement manufactory. Messrs. Johnson & Wilson, general selling agents for Saylor's Portland Cement, have introduced the use of bags for packing cement, or they will ship in bulk, to any point, in full car load lots. They have already supplied, *in bags*, to Messrs. Carnegie Bros., of Pittsburg, 3040 tons of Saylor's Cement, equivalent to 16,000 barrels or $4,000 saving to the purchasers; they have also supplied *in bulk*, large quantites of cement to the Central City Pipe Works, Syracuse, N. Y., and are now filling several other large contracts for delivery *in bulk*. The question of barrel, bag or bulk is one of sufficient importance to merit investigation by purchasers of cement in considerable quantities.

Bridges.

THE Pittsburg and Lake Erie began running trains across the Beaver bridge on the 21st ult. They were just nine days completing the branch of over three hundred feet, in which over three hundred thousand feet of lumber was used.

SENATE bill authorizing the Mahoning, O., county commissioners to issue bonds for building a bridge across the Mahoning River in the city of Youngstown, is a law.

THE public are cautioned from crossing the bridge on the California and New Richmond Turnpike, State of Ohio, over the Little Miami River, the same being in an unsafe condition.

THE bill to authorize the Board of Public Works to build a permanent and substantial levee in the Eighth ward of the city of Zanesville, extending from the wing of the National road bridge to the Fifth street bridge over the Muskingum River at Zanesville, O., has passed the Ohio Legislature.

THE suit between the Trustees of the East River bridge and the Manhattan Co., concerning the Chatham street station and its removal, promises amicable settlement. The elevated road will move provided they have access from the level of their road to the bridge; so it appears now.

PITTSBURG, PA. Councils have voted $300,000 for a Free Bridge to the south side.

MONTREAL, Feb. 27.—A bridge over Spring Creek, near Fredericksburg, on the Grand Trunk Railway, gave way yesterday while a freight train was passing over it. Eleven cars loaded with general merchandise fell into the bed of the creek. Seven of the cars were smashed into splinters.

IT is stated that the project for the construction of an ocean pier at Nantasket Beach, between the Nantasket and Ocean Houses, is to be pushed, that the pier will be 1,400 feet long, extending to deep water, and that the roof, floor and sides will be so arranged as to be removable in winter.

ROCHESTER, PA., Feb. 19.—The temporary bridge over the Big Beaver failed to stand the strain of an engine and a train of cars loaded with iron ore passing over it last night, and as a consequence the C. & P. road will have to use the Fort Wayne road from Alliance to Pittsburg for a few days longer. The deflection of the structure was about twelve inches.

LOUISVILLE, Ky., Feb. 25.—The iron bridge over the Bear Grass Creek, on the Cincinnati Short Line, in the eastern part of the city, gave way to-day, falling just after a train had passed over it. The accident was caused by the giving way of a stone abutment which had been injured by the flood. Trains will leave from the eastern station until the bridge is rebuilt. The bridge was regarded as one of the best on the road. It was 150 feet long and 60 feet high, and is almost a total wreck.

Two bridges across the Susquehanna will require 11,000 tons of manufactured iron besides which numerous smaller structures will be required. The shipyard demand also promises to be well maintained, while there is a possibility of very important requirements for cable or elevated roads. Taking it all in all, therefore, the finished iron trade gives some promise of improvement, although it cannot be said that anything of that kind has been realized as yet. Sales during the week have been on the basis of from 2.2 to 2.3 for boat plate, tank iron and angles (according to quantity) 2.75 for T's and 3.5 for beams and channels.—*Phila. Press.*

THAT BIG BRIDGE SCHEME.—If reports are true, the bill giving certain persons a charter to build a bridge between Covington and Newport and Cincinnati and Newport has passed the House at Frankfort, Ky., but has not as yet been considered by the Senate. The charters are superior to those of the great street railroad bridge of Eugene P. M. Creutz, which only asked the Legislature to grant him the privilege of building a street railroad around Newport, including the Ohio shore. This bridge bill, it is understood, if passed, will give the company a charter to build bridges in Ohio, Indiana and Kentucky, which, of course, is absurd, to say the least. The main object in obtaining this charter, seemingly, is to keep it for speculative purposes in the far future. The Legislature is granting too many of this class of charters.—*Cincinnati Enquirer.*

Railroads and Canals.

THE Norfolk and Western R. R. Co., reports an increase of earnings of $5,488 for January, 1884, over that of January, 1883.

PETERSBURG, Va., wishes to issue $50,000 worth of bonds to aid in building the Virginia and North Carolina Railroad from Richmond through Petersburg to Ridgeway, N. C.

THE Canadian House of Commons has passed a bill granting a loan of nearly $30,000,000 to the Canada Pacific Railway.

IT is understood that the Virginia General Assembly will ask to grant a charter to build a narrow-gauge railroad from Petersburg to Matoaca, in Chesterfield, with the privilege of extending it to the coal region of that county.

A COMPANY, with a capital of 1,440,000 florins, has been formed at The Hague for constructing railways in Java. The founders have subscribed the capital. It is stated that there is some talk at Amsterdam of the foundation of a company, with 50,000,000 florins capital, to construct new railways and take over from the Government the working of the existing railways in the Dutch Indies.

THE INDIANA RAILROADS.—State Statistican Peel has furnished the following regarding the railroads in Indiana:

Total value of railroad property	$53,480,932
Miles built during 1883	341.75
Miles now in operation	5,240.15
Expenditures for improvements	$ 1,318,528
Total value of rolling s ock	$10,702,250
Number of fatal accidents	121
Number of injuries	305
Amount of damages recovered	$ 3,954.89

THE first part of the annual report of the Mass. Railway Commissioners, a book of 270 pages and a new map of the railroad system of the State, has been published.

DES MOINES, Feb. 26.—The articles of incorporation of the Kansas City, Des Moines & Northern Railway Company were filed to-day. The object is to build a road between the cities named. The incorporators are chiefly residents of Missouri and Iowa.

EX-JUDGE HILTON has purchased from Mrs. Cornelia M. Stewart, widow of the late A. T. Stewart, the Stewart property on the east side of Broadway extending from Chambers to Reade streets. Mr. Hilton paid the sum of $2,100,000.

BILLS to incorporate the Covington, South Covington and Latonia Springs Railroad Company, and also the Covington Inclined Plane and Narrow Guage and Elevated Railroad Company, were introduced in the Kentucky Legislature on the 19th ult.

THE Stanislaus River Mining & Tunnel Company, at East St. Louis, to mine the gravel-bed of the Stanislaus river in California and change the river's course, capital $1,000,000; incorporators, F. H. Woodworth, E. R. Wright, and John Boyle, of St. Louis. Incorporated at Springfield, Ills., Feb. 18.

SELINSGROVE, PA., Feb. 21.—H. M. Hamilton and Francis Stable, representing the Seaford, Pennsylvania & Western Railroad, have been through part of Mifflin county, settling claims for right of way for the new road. It is stated that a branch road will be built from Port Treverton through Selinsgrove to connect with the Delaware & Lackawanna road at Northumberland.

From the time that the first dirt was turned in Mexico for the construction of the Mexican Central Railroad, the company has built an average of one mile of track per day. The 1225 miles of main line from El Paso to the City of Mexico will be completed within the shortest time ever named by the company or any of its officers.

"THEY are now letting the contracts for the South Pennsylvania Railroad," said William J. Nead to me yesterday afternoon. "The whole line, some two hundred miles long, is to be let in sections, according to the capacity of the contractor, and it will take about three years to build it. This line runs from Harrisburg, where it joins the Reading System, to Wheeling, West Virginia. When finished it will make the Reading road a trunk line, competing with the Pennsylvania for Western business. I do not know yet how much of the road I will get to build, but the Vanderbilt interest backing this enterprise seems to intend to push the construction vigorously."—*Philadelphia Press*, Feb. 28.

HEAD & DAWST of Manchester are the contractors for building a new union railway station in Concord, N. H., which is to cost $100,000. The foundation was put in last year and the superstructure will be begun as soon as the weather permits. The edifice will be 218 feet long, 62 wide and three stories high. It will have a routanda 60 feet high. The passenger room will be 65x60 feet. The building will be used for general public purposes, and will have among other conveniences, a telegraph office, ladies parlor, smoking room, toilet apartments and a commodious restaurant. The second floor will contain offices for the President, Superintendent, Treasurer, and Directors. Smaller offices for the clerks and others will be located on the third floor. The first story will be 16 feet in height, and the second and third 12 and 11, respectively. The structure will be built of faced brick, with granite trimmings, and will be surmounted with a hipped roof of slate, with large gables.

SOURIS & ROCKY MOUNTAIN.—A Toronto dispatch says: It is stated that a Philadelphia syndicate is ready to put up $8,000,000 immediately on the order in council being passed granting the land. They will build 1,050 miles from Melbourne, beyond Edmonton. The land grant will be 6,400 acres per mile, not 3,840 as formerly. Eight millions of stock is to be issued. Walter Shanly is to be the chief engineer of the work. The temperance Colonization company promises 860,000 acres if the road is completed to the colony, 250 miles, by the first of 1885.

[This is an ill-flavored enterp ise and subcontractors will do well to investigate the "Philadelphia Syndicate" before investing any time or money. We happen to know something about the responsibility of the "Contractor" from personal experience.—ED. ENG. NEWS.]

WORK upon the Ohio & Guyandotte road, in which considerable capital is invested, will be commenced within two weeks and will be pushed forward with considerable rapidity. The supplies have already been contracted for and will soon be delivered at various points along the line. The work will be done under the supervision of the New York Construction Company.—*Pittsburg (Pa.,) Paper*, Feb. 22.

THE purchasers of the Meadville & Linesville railroad have been granted a charter, the capital stock being $200,000. The road is 21 miles in length running from Meadville to Linesville, Pa. The directors are: W. Wallace Delamater, president, and A. C. Hudekoper, Lewis Walker, D. S. Richmond, T. A. Delamater, W. S. Magungle and H. L. Richmond, Jr.

QUINCY, JACKSONVILLE & EASTERN—Incorporated in Illinois to build a road from Quincy through the counties of Adams, Pike and Scott to Jacksonville. The incorporators are: Henry Root, I. Lesem and F. W. Meyer, Quincy; C. M. Grammar, Beverly; Judge Higbee, Pittsfield, and the Hon. I. L. Morrison, and Louis S. Olmstead, Engineer, Jacksonville. The preliminary survey is to be commenced at once.

WYOMING SOUTHERN—Incorporated in Wyoming territory to build a road from Cheyenne to the boundary line of Colorado. The capital stock is $500,000, and the incorporators are: Luke Voorhees, Edward A. Slack, Francis E. Warren, Morton E. Post and George Francis Morgan. It is proposed to operate the road in connection with the Cheyene, Black Hills & Montana road, and it will also prove a feeder to the Burlington & Missouri River railroad.

WASHINGTON, Feb. 27.—At a meeting of the House Committee on Railways and Canals today favorable reports were ordered on Mr. Hoblitzell's bill appropriating $1,000,000 for the construction of the Maryland and Delaware Ship Canal; Mr. Wemple's bill providing for the appropriation of $1,000,000 annually for ten years for the permanent improvement of the Erie Canal, and to aid in maintaining the same free to the commerce of the United States, and Mr. Brent's bill providing for an appropriation for the construction of a ship canal from Union Lake, in Washington Territory, to Puget Sound.

MINNEAPOLIS, MINN., Feb. 24.—A contract was signed in New York on Friday, between President Robert Harris, of the Northern Pacific, and President W. B. Washburn, of the Minneapolis, Sault Ste. Marie & Atlantic Railway Company, whereby the latter corporation secures a joint use in perpetuity of the extensive terminal facilities of the Northern Pacific Company in Minneapolis, including the iron bridge across the Mississippi. This is understood to be a step in the direction of making the Minneapolis & Sault Ste. Marie Road practically an eastern extension and outlet of the Northern Pacific.

SUFFICIENT money has been secured for building the Thomasville, Tallahassee and Gulf railroad.

All of the Georgia Pacific officers have folded their tents and removed to Birmingham, Ala.

Another large crowd of negro laborers left on the Georgia Pacific yesterday for Tuscumbia, Alabama. Like those who preceded them on Thursday, they will be employed on the new road from Sheffield to the Georgia Pacific.—*Atlanta Constitution*. Feb. 22.

MESSRS. ANDERSON & BARR have obtained a contract for building the foundations of the five piers of the Little Rock, Ark., railway bridge, of the Little Rock Junc. R. R. Co. Four of these piers are on pneumatic caissons, one upon piles; the foundations will be about 50 ft. below low water mark. This work is to be finished by Sept. 1, 1884. In the bridge there are three spans of 250 ft. each, and a draw with openings of 160 ft. clear on each side of draw pier. The bridge carries one line of rails and a highway crossing.

THE Mount Desert branch of the Maine Central R. R. is nearly completed. The rails are laid and the road partly ballasted from Bangor to Ellsworth, and by the terms of the contract, the remaining portion to Hancock, the nearest point to Bar Harbor, will be finished by June 1, 1884. The work has been under the general direction of William A. Allen, engineer of the Maine Central R. R. The engineers for the contractor, Jos. M. Greene, were B. F. Hancox, Chf. Eng., and Hilliard F. Danforth and H. A. Hancox, Division Engineers. The length of this branch is 39 $\frac{74}{100}$ miles of main line; the maximum curve is 8° and the maximum grade is 1 $\frac{5}{10}$ per cent. There are only 450 lineal feet of bridge on the road; all masonry is well built granite work. Steel rails and cedar or hackmatack ties make up the roadway.

THE tunnel on the Denver and Rio Grande R. R., near Bridgeport, Colo., will be completed this week, at an expense of nearly $200,000. The work has been done by the railroad contractors Ormond & Crooks, of Pueblo, under the management of their Superintendent, Mr. L. Maloney. From 300 to 400 men have been kept at work since early last fall under his management, gangs working from each end toward the centre.

The tunnel is 16 feet wide by 21 feet high, cut through solid rock. The engineering work has been performed with great accuracy and precision by B. H. Bryant, formerly of St. Louis, Mich., the engineer in charge, as was demonstrated when the two gangs met at the centre, and the opening was effected.

MR. A. DANAHY has the contract for the Kansas City Belt Railway. By the conditions of the contract Mr. Danahy is to do all the necessary grading and to make yards from the Blue river to the Chicago and Alton and Missouri Pacific tracks. In order to do this two hills containing 200,000 cubic yards of material to be removed east toward the Chicago and Alton and Missouri Pacific tracks where a large fill is necessary. A third hill containing 30,000 cubic yards of rock and 10,000 cubic yards of earth will be used to fill in near the Blue.

Mr. Danahy expects to commence work by the 10th of March, and for that purpose will at once remove to Kansas City a steam shovel, at present in Arkansas, and a crew sufficient to operate it. This, together with narrow gauge engine and 100 cars, will be kept in operation night and day until the work is completed. About 400 men will also be employed.

COSTS OF SURVEYS.—WASHINGTON, Feb. 21.—The House Committee on Pacific Railroads today agreed to favorably report a bill prepared by Representative Crisp, which is a substitute for bills introduced on the same subject to compel Pacific railroads to pay the cost of surveying and selecting lands that have been granted to them by act of Congress.

In default of payment within sixty days after the passage of the proposed act the Attorney General is directed to bring suit against the defaulting roads. Until the question of forfeiture of lands granted to the Northern Pacific Road is determined by Congress the provision of the bill acted upon to-day cannot apply to that railroad company.

About 35,000,000 acres of land have been earned in good faith by Pacific railroads, one-seventh of which had been patented. The Government has surveyed over 29,000,000 acres, and for this survey the railroads owe about $800,000. The passage of the act will compel the Pacific companies to pay taxes to the States in which the land is. Of these States Kansas, Nebraska and Colorado are most interested.

The Union Pacific has earned about 13,000,000 acres of its grant, 2,000,000 acres of which have been selected, leaving 11,000,000 acres for which the cost of survey will have to be paid. The action of the committee will be reported to the House on Monday.

DIDN'T GO.—"I say, Mr. Railroad man," remarked a determined-looking woman, as she entered the Petaluma station, the other day, "where's the man that pays damages to widows and orphans?"

"Have you a judgment against the company?" said the pasteboard dispenser.

"I've got my own judgment that this concern owes me about 5,000 hard John dollars. My husband fell off your drawbridge out here while out duck-hunting last Tuesday, and I thought I'd just drop in and settle on my way home from the cemetery. Show me the man with the sack."

"Did a train run over the deceased?"

"Run over him—of course not—suppose he was a snail? He was kicked off the bridge by Tom Thompson's old goose-gun and broke his neck."

"I'm afraid, madam," said the urbane dispenser of stop-overs, "that your claim has not the proper legal elements to warrant its adjudiction."

"Talk Californian, young man," said the widow.

"I mean that duck-shooting damages don't go."

"Don't, eh? And I've got to turn to and pick hops this winter to support the family, have I?"

"Looks that way, I'm afraid."

"Oh, it does, does it?" screamed the indignant relict. "That just settles your hash. I'll just sell Henry's old clothes and his pointer dog, and start an anti-monopoly paper down at Shang Landing right away. If I don't make your rotten old thieving corporation get up and howl before I'm through, it'll be funny. Tell old Crocker to lookout for himself," and upsetting the water-cooler with a vicious jab of her umbrella the female Kearney switched out. —*'Frisco Post.*

THE surveyors for the Winona, Alma and Northern Railway are at east Dubuque, Iowa, for the purpose of locating the line of the road at that place. The new tunnel will run east of the present one, and will be 2,400 feet long.

THE Broadway Underground Railway Co. has applied to the Legislature to have its name changed to the New York Arcade Railway Co. They want to build an arcade instead of a tunnel. The plan now is to build a four track road, supporting the street on posts, with two sidewalks below. The company must also provide for the sewers, water, and gas and all other pipes, wires, etc. The bill provides for the appointment of a Commission by the Governor, to supervise the whole work, and see that it is properly conducted without damage or inconvenience to the citizens.

SOME very quiet but effective work is being done by the projectors of the St. Joseph & Rio Grande railway. A construction company has been organized in this city and a handsome sum subscribed for the construction of the road, which has been surveyed to the western line of Kansas and located for a considerable distance. Mr. A. B. Thompson, engineer in chief, has an office in room No. 1, in the old *Gazette* building on Fourth street, and is busily engaged in draughting profiles and plans of bridges and making up estimates for that portion of the line which will be let to contract as soon as winter breaks. Mr. Thompson has filled the position of chief engineer for some of the leading railways both in the east and west and ranks high in his profession.

While the work is progressing in this way at this end of the line, Col. Geo. Youngs, the moving spirit in the enterprise, and a man who has probably built more miles of railway than any other man in the west, without any flourish of trumpets, is visiting one township after another along the proposed line in Kansas, and is securing such aid in the way of bonds as will make the building of the road in the near future a certainty.—*St. Joseph* (Mo.) *Gazette*.

ALONG THE SOUTH PENNSYLVANIA ROUTE.—The Collins Brothers of Philadelphia, among the most widely known railroad men in this country, have been awarded the contract for building that portion of the South Penn Railroad in this county between the Allegheny and Laurel Hill tunnels. Their contracts embrace some twelve miles, and includes the Quemahoning tunnel. One of the firm is in Somerset at present for the purpose of going over the line and making contracts for the erection of all needed buildings. They expect to commence work as soon as the weather will permit.

The first picks have been struck at the Tuscarora tunnel, in Path Valley. Week before last Messrs. Mason & King, the contractors, forwarded to the tunnel forty head of horses and mules, about thirty-five carts, besides tools, etc. A number of colored men from Kentucky also arrived a few days ago, they having been employed by these contractors on the Richmond & Mecklenburg Railroad. The tunnel will be over one mile in length, standing third in size of the eight tunnels. The contractors believe it will require at least two and a half years to complete the work.

There are 250 men at work on the Ray's Hill tunnel. Of these 150 are divided into three gangs of fifty men each, and each gang works eight hours in the tunnel, so that work is kept up during the entire twenty-four hours. The remaining 200 men are at work on the cuts and fills at the approach of the tunnel. About the same force, divided in the same way, is at work on the east end. Arrangements are being made to use electric light in the tunnel. The men get $1.25 per day for their work, and they pay $16 per month for boarding.

Putman & Kuhns have been awarded the contract for the construction of Laurel Hill tunnel, and will commence operations as soon as they can prepare shelter and accommodation for their laborers.—*Phila. Press*.

WISCONSIN CENTRAL PROJECTS.—MILWAUKEE, WIS., Feb. 19.—Private dispatches from Boston verify the press report that President Colby, of the Wisconsin Central Railroad, has secured from Boston capitalists $2,500,000 to complete the Central system from its present terminous at Chippewa Falls, to St. Paul. The information is given out from the Central headquarters here, that the money has been secured, and that work on the important feeder will be pushed with great rapidity. Locating Engineer W. O. Seymour, telegraphed from St. Paul last evening, that he will to-day complete the location for the Wisconsin Central's extension to that city from Chippewa Falls. This location, starting at Chippewa Falls, makes gradually north in running west, and on reaching the Mississippi River, 70 miles west of Chippewa Falls, is about 12 miles north of the starting point. Its course is nearly parallel with the Omaha's main line, and 10 miles north of it. The road crosses the Mississippi River about three miles north of Stillwater, and from there takes a direct shoot to the southwest, through Stillwater and into St. Paul. The road will be about 104 miles in length, and cross the North Wisconsin division of the Omaha road at New Richmond, which is the only town of importance touched between Chippewa Falls and the river. The construction work will be done by contract, and it is expected to have everything in readiness to begin work, just as soon as the weather will permit, and from that time pushed vigorously until the road is completed, which will undoubtedly be before the close of the present year. It is the general belief here that the Central will furnish an outlet for the Northern Pacific, and that one branch will be from St. Paul, by way of the new line to Chippewa Falls, and thence to Milwaukee, and the other from Superior City, the present eastern terminus of the Northern Pacific, by way of Ashland, and then along the Wisconsin Central. The company proposes to build a line, 90 miles long, from this city to Chicago. Railroad men are watching the Central's movements with great interest.

Gas and Electricity.

LAFAYETTE, Feb. 21.—This city has closed the contract for street lighting for three years, making the award to the Lafayette Gas Company. The price paid is $25 per annum per post, lamps to burn 2,200 hours per annum, burners to be sixteen candle power. Private consumers secure gas at $2 per thousand feet; present price $2.50.

NATURAL GAS INVESTIGATION.—The committee appointed by the Western Pennsylvania Engineers' Society to investigate the dangers of natural gas, which is being brought to Pittsburg from different directions, have been diligently at work during the past few weeks making a most thorough examination of the different gas wells within a radius of 100 miles or more. They have almost completed their labors and have gathered considerable important data and information which will be embodied in their report to be submitted at the next meeting of the society. Although none of the committeemen are disposed to give the result of the examination so far as it has gone, it was ascertained that they have found natural gas a dangerous explosive, which will require considerable care in distributing, both for heating and illuminating purposes, to render it safe. This is owing to the pressure, which is far greater than ordinary gas, and, therefore, in case of a leak, much more dangerous. The committee thinks, however, that by regulating the pressure by tubes, &c., it could be made perfectly safe. The gas issuing from some of the wells was found to be inferior to that at others for heating and illuminating purposes, there being more or less oil vapor at different wells.

THE ELECTRIC LIGHT COMPARED WITH GAS AFTER A YEAR'S TRIAL.—Octavius E. Coope tells the London *Times* his experience in lighting Bere-church Hall with the electric light for a year. The place has been lit by 200 Ewan lights of 18 candle power, run by four dynamos and a twelve-horse power engine. The total cost of fillings and plant was $7,450 against $6,666 for gas, to accomplish the same purpose, and the estimated annual expense was put at $1,160, or half a cent (4.75 mills) per eighteen candle power per lamp per hour. The actual cost has been $1,795, and as the lights ran 1823 hours apiece instead of 1150, and a twenty candle power, as estimated, the cost was still a little less than half a cent an hour. The cost of gas in this city is, at $2 per 1,000, just a mill a foot, and the cost of gas here is, therefore, four times what Mr. Coope has found the electric light to be. Of the result he says:

"The light is quite as easy to manage as gas, while the softness, the purity, and the agreeableness are such that a return to any other method of illumination would be now quite out of the question. The pictures, books, and decorations have no chance of injury; the ceilings and walls remain unsoiled, while the difference of health felt after sitting an evening in a room electrically illuminated and another lighted with gas, must be experienced before it can be appreciated."

Mr. Coope gives the important practical suggestion that instead of "bunching" the lights, they ought to be scattered to get the best effect.

To spread the electric light in England has led to attempts to improve gas, and the gas company of Chesterfield has recently erected a gas lamp illuminated on the Siemens system of gas lighting. The gas is heated before coming to the flame, and there is complete combustion of the gas, giving a brilliant white light, and so pure that even delicate shades of color can be detected as in daylight, which, of course, is not the case with ordinary gaslight. The illuminating power of the light is equal to 350 candles; and by means of a testing meter it was ascertained that the consumption of feet per hour was 48. Electricity has been for some time used by the authorities of Chesterfield for lighting their public thoroughfares, to the exclusion of gas; but the electric light having very frequently broken down of late, leaving the town in semi-darkness for a time, there is every probability of gas being again resorted to, particularly as this new lamp has proved so successful.

IRON, METAL AND COAL MARKETS.

PHILADELPHIA, Feb. 28, 1884.

The week, so far, has not developed the expected activity in Pig Iron and only small lots are being called for; prices, however, are well maintained, and although even inquiry is for small lots, makers are hopeful, and no decline seems to be threatened. Standard Foundry is quoted at $20.50@$21.50, and ordinary has sold at $20 for No. 1; No. 2, $19 for most makes; Gray Forge sells all the way from $17.50@$18.50; Bessemer Iron is under good inquiry but no business of importance has been closed although some will probably be reported within a week or two; quotations are nominally, $20@$20.50; Spiegeleisen, $29@$29.50 asked for 20 per cent.; Muck Bar is quoted at $3, with little doing; Finished Iron is still in active demand in small lots, at about 2c. at mill, for best refined, although sales have been made at 1.90 and even as low as 1.80, for iron of which the quality was not guaranteed. Only a few thousand tons of Steel Rails have sold within the past week, at $34.50@$35; there are inquiries in hand for 15,000 to 20,000 tons more; makers are still holding firmly to $34 as their lowest figure for large lots, and say that $35 is the lowest for small lots, but they have accepted $34.50 for some moderate lots during the week. Buyers are still confident that they will eventually secure better terms. Crop ends are quoted at $18.50@$19.50 with offers at less. Scrap Iron, $24 for best No. 1. Nails, $2.50@$2.60.

PITTSBURGH, Feb. 28, 1884.

Prices for Crude and Finished Iron may be reported rather firmer, on account of the great activity of the past week, although no actual improvement has taken place. The demand for Pig Iron, especially for mill use, has been better than for two or three months, and lots of 100 to 500 tons have sold freely, at $17.50, $17, and $18, according to make and size of order. Foundry Irons have sold in smaller lots, at from $18@$21, according to No. and make. Production is rather light, stocks are low, and the prospects for the spring trade are generally considered fair Small lots of Refined Iron have been selling freely at 1.70@2c. All the mills that were stopped by the floods, have resumed and will be actively employed for some time to come. Most of the nail mills have started up again, and demand is improving; prices are firm at $2.50@$2.60, and inquiries for spring supplies are beginning to arrive. Muck Bars are in dull request at about $32; Bessemer Pig, $21. Wrought-iron Pipe, dull; quotations unchanged. Steel Rails, $35@$36, at mill, for prompt deliveries; no large orders reported.

CHICAGO, Feb. 27, 1884.

A generally improving tone is to be noted in this, as in other western markets, although the volume of business for the past week has not been large; confidence, however, is increasing and prices in several directions have hardened slightly. About the only decided advance which has been attempted, has been in nails, which dealers have advanced to $2.65@$2.75, according to size of order; buyers see no reason for this, however, and demand has fallen off; but increased business must be presented in a short time, as the building season will soon commence, and it is probable that dealers will be more successful in obtaining their asking prices after a few weeks. Manfactured Iron, of some kinds, is in better request, but Bars are rather weaker than at last report and the movement is light at $1.90@$2.00; Structural Iron is quoted at 2.50@2.60 for Tank, 2.60 for angles, 3.60 for Beams, and 3.80 for Channels; concessions could be obtained on large orders. Galvanized Iron is in fair demand, at old prices. Steel is more active than for some time, both in high and low grades and less cutting of rates is reported. Steel Rails are quoted at $35.50@$36 f. o. b., at western mills, and few contracts are being placed. The prospects are fair for a good spring trade in Hardware. Shelf goods have been in active demand; trade in builders goods is improving, on account of the mild weather.

COAL.

PHILADELPHIA, Feb. 28, 1884.

The Anthracite coal trade is still dull, and stocks are accumulating at shipping points. The local demand has fallen off, and the line trade is dull; the only active demand is for the smaller sizes. The shipments of the Reading Company, for the week last reported, were 158,000 tons. Freights are low, being quoted at $1.25@$1.40 to Boston, and $1.10@$1.25 to Providence. A better demand for Bituminous Coal is expected, owing to the tendency among consumers to use it, where they formerly used Anthracite. But this advantage will probably be offset by the increased competition between the Bituminous operators, on account of the largely increased production for which arrangements have been made. Shipments of Bituminous coal to eastern markets for week last reported, 81,478 tons, as against 95,336 tons for corresponding week last year. Cumberland shipments have declined to about 26,000 tons.